# Introductory Editorial: The Merits of Measurement

The goal of nutrition education is to facilitate consumers making informed food choices that ultimately enhance dietary quality and promote health. Nutrition education is an intervention process (ranging from individualized counseling to population-based approaches that include efforts such as social marketing and informational campaigns) that seeks to change behavior. To evaluate such intervention efforts, it is essential to set program objectives and examine program outcomes.

As objectives are being set, the evaluator must decide how to measure key variables. Measurement is the key link between the setting of program objectives and the examining of program outcomes. Choosing the correct tools to measure those variables specifically linked to the intervention is essential to the success of any program evaluation effort. We determine program effectiveness by comparing the match between program outcomes and program objectives. Often an evaluation can be designed well and the appropriate statistics employed, but the results of the comparison between program outcomes and objectives can be disappointing or even misleading. Good program evaluators know not only how to measure the "right" things but also how to measure things "right" in terms of choosing appropriate measurement tools.

Contributors to this special issue of the *Journal of Nutrition Education* are to be commended for their efforts to develop methodology and validate instruments to support evaluation of nutrition education in the Food Stamp program. These help identify tools to measure program impact, thus helping to improve the overall quality of our program evaluation efforts in nutrition education for limited-resource families.

Food consumption behavior is influenced by a myriad of factors from individual social-psychological variables to community and policy influences. Gregson et al. have used the Social-Ecological Model as a theory-based framework to identify this range of influences and suggest indicators that are appropriate to measure changes at community and state levels. The process measures and partnerships described in this are important to developing ongoing efforts to effectively leverage and reinforce nutrition education activities directed toward individuals and families.

The other articles in this special issue address some specific issues affecting measurement of nutrition education outcomes such as food shopping practices (Hersey et al.), food safety behaviors (Medeiros et al.), and the importance of measuring dietary consumption in the context of physical activity (McClelland et al.). Nutrition educators who work with low-income families realize that the challenges they face are even greater than those faced by families with more adequate resources. Low-income families must also deal with issues of obtaining adequate resources with which to obtain food (in adequate quantity and quality) at the same time they are dealing with the whole range of issues that affect food choice behavior. The issue of food security is therefore essential to address in nutrition education efforts. Keenan and coauthors review the work in this area and identify several effective tools to assess food insecurity.

Together these articles in this Special Issue help to expand our appreciation of the range of nutrition education programming and identify measurement tools to assist in proving rigorous and timely evaluation of nutrition education with low-resource populations. The success of our efforts to evaluate nutrition education is only as sound as our ability to measure what changes have occurred. I encourage researchers and educators to consider this review as an aid in fostering ongoing improvement of evaluation efforts in nutrition education. These articles are not intended as a "final word" on the topic; *considerable research is ongoing to develop new and validate existing evaluation instruments,* but the tools identified here represent a useful beginning to demonstrate the efficacy of our efforts and achieve the goals toward which nutrition education strives.

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# Tools to Assess Nutrition Education with Low-Income Families

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The U.S. Department of Agriculture (USDA) has long been committed to improving the nutritional health of Americans through a program of research and education to maintain a food supply of high nutritional quality and encourage consumption of a healthful diet. The food assistance programs administered by USDA are a cornerstone of this country's effort to ensure adequate nutrition for the disadvantaged. In recognition of this responsibility, USDA has worked to make quality nutrition education available to the largest possible number of participants in food assistance programs.

Most recently, USDA has encouraged states to use an optional nutrition education provision contained in the Food Stamp Program regulations in an effort to increase access to nutrition education for participants in this program. Nutrition education in the Food Stamp Program has grown to nearly $200 million in funding shared between the states and the federal government in 49 states and one territory. The Food and Nutrition Service (FNS), which oversees the operation of the Department's nutrition assistance programs, including the Food Stamp Program, seeks to encourage evaluation efforts to address issues regarding the accountability and the continuous improvement of these nutrition education programs. Consequently, under the auspices of the Department's Economic Research Service, a cooperative agreement was awarded for the development of methodology and validation of instruments to support evaluation of nutrition education in the Food Stamp Program.

The following articles were written to help states evaluate their of nutrition education efforts in the Food Stamp Program. These articles may be a resource for evaluation of a broad range of nutrition education programs. In addition to comprehensively reviewing relevant research, these articles provide recommendations and guidance to assess nutrition education and social marketing efforts with diverse, low-income populations. They identify the tools to help address issues of program accountability and continuous improvement. Although nutrition educators understand the importance of measuring program impact, they may not be aware of the instruments available to do so and, as such, are continually "reinventing the wheel." Hopefully, these articles will assist in reducing the amount of effort directed toward creating a new instrument for every new program. Also, even if educators are aware of some of the instruments that are available, they may not know the limitations of these instruments. These articles should assist practitioners in both of these scenarios and perhaps help to create more widespread adoption of outstanding instruments, thereby improving the overall quality of evaluation and increasing the number of programs reporting on the same indicators. They focus on five topic areas that an FNS expert panel identified as those that reflect the primary emphasis of nutrition education in the Food Stamp Program. These topic areas include

1. *System, environmental, and policy changes*—"to bring change to the system or environment that makes nutritious diets more available to food stamp households."
2. *Food resource management*—"to enhance practices related to thrifty shopping for preparation of nutritious foods."
3. *Food safety*—"to improve households' safe handling, preparation and storage of food."
4. *Dietary quality*—"to motivate consumers to adopt eating and lifestyle behaviors that are consistent with the Dietary Guidelines for Americans and the Food Guide Pyramid."
5. *Food security*—"to ensure that individuals and families have enough to eat without resorting to emergency food assistance."[1]

These topic areas are interrelated; cooperation and collaboration among partners result in increased coordination, changes in policy, and increased resources for nutrition education. These actions are expected to increase access to nutrition education and nutritious foods. Nutrition education can help to positively affect food resource management and increase food safety, which, in turn, can improve dietary quality and food access. Dietary quality and food security (which includes food access) are anticipated to promote health and financial independence.

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# Integrating Evaluation Tools to Assess Nutrition Education

Evaluation is important for accountability, for planning, and for learning how to continuously refine and improve nutrition education with low-income families. The tools described in this special issue are intended to provide a resource to such evaluations. The special issue grew out of a series of USDA working groups to identify evaluation tools for nutrition education with low-income families.* I express my thanks to the many individuals who contributed to this effort.

**Tools for Evaluation.** The results of this work, as reported in this special issue, help broaden our appreciation of the ways by which nutrition education programs can influence behavior, and ultimately the health and independence of low-income families (see Figure 1). Effects on system, environmental and policy changes can enable and reinforce individual nutrition behavior. Nutrition education can affect food shopping practices and food resource management, food safety, dietary quality and physical activity, and food security.

*System, Environmental, and Policy Change.* The paper by Gregson et al presents a social-ecological framework that helps describe the levels of influence on nutrition. Because nutrition is an ongoing process, the paper reminds us that nutrition education programs require a sustained, and multifaceted effort. It describes the value of process measures to characterize program development and implementation, such as the range and strength of partnerships to increase the reach and resources for nutrition education. The paper underscores the value of sharing information about system and policy changes and assessing the effects of those changes on low-income families.

*Food Shopping Practices and Food Resource Management.* The paper by Heresy et al investigated tools to measure food shopping practices and food resource management B issues that can pose particular challenges to low-income families. The study found that commonly taught food shopping practices were significantly associated ($p < .05$) with nutrient availability in the 1996 National Food Stamp Program Survey and with consumption of nutrients by women who participated in the Expanded Food and Nutrition Education Program (EFNEP).

*Food Safety.* The paper by Medeiros et al helps to address the lack of validated measures of food safety practices by identifying five behavioral constructs that will be particularly useful to assess: personal hygiene, cooking food adequately, avoiding cross-contamination, keeping food at safe temperatures, and avoiding food from unsafe sources.

*Dietary Quality, Weight Management, and Physical Activity.* The paper by McClelland et al helps in measurement selection by describing the reliability, validity and sensitivity to change of dietary quality measures with low-income audiences. The paper suggests, that in addition to 24-hour recall measures, a number of Food Frequency Questionnaires have considerable potential for use when nutrition education programs that target a particular area of the Food Guide Pyramid. The paper also describes measures of weight management and physical activity that can help to evaluate the effects of nutrition education in preventing obesity.

*Food Security.* The paper by Keenan et al describes the ways that nutrition education can influence food security and describes the evidence for the reliability and validity of tools in this area. While the sensitivity of these measures to changes over time needs to be assessed, this can be accomplished through the use of these measures in evaluation studies.

**Research Design.** While the emphasis of these papers is on measurement tools,

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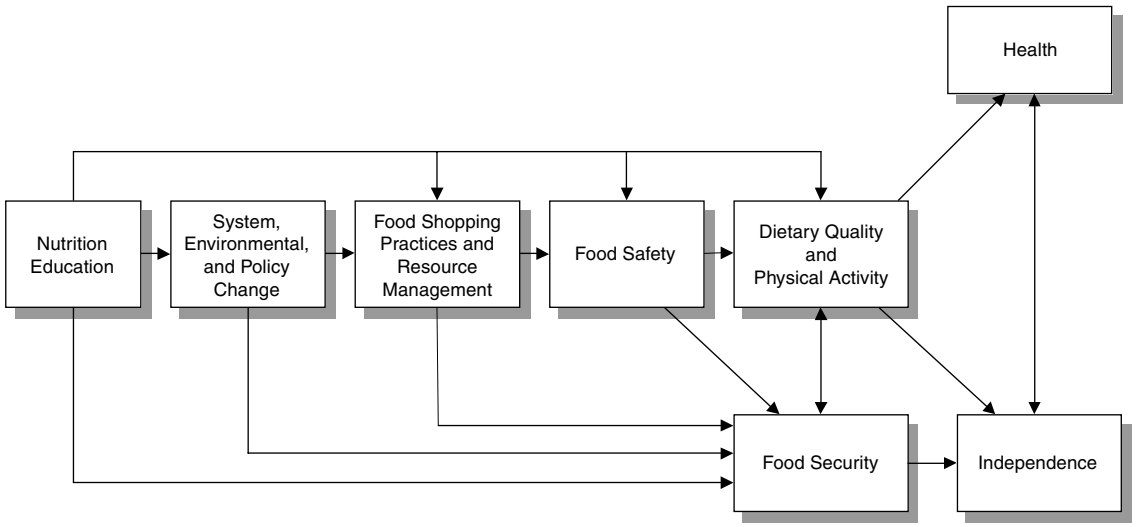


**Figure 1.** Nutrition education can have widespread effects on health and independence.

the role of thoughtful research design in applying these tools is evident. While issues of research design are well treated in a number of texts on evaluation, [1-4] two points deserve emphasis here. First, it is important to include comparison groups. Comparison groups can do much to distinguish the effects attributable to a nutrition education program from the potential influences of broader time trends in eating patterns (i.e., secular trends) and the tendency of respondents to offer responses that they think will reflect well on themselves and the nutrition educators who helped them (i.e., social desirability). There are a number of options to create comparison groups, including randomized assignment to alternative types of programs, randomized assignment of matched units (e.g., schools, program offices, supermarkets, communities, or neighboring states). The appropriate choice for a comparison group may be determined by the persistence and creativity of researchers based on the opportunities and practicalities of conducting nutrition education with low-income populations in their communities.

Second, nutrition education interventions often involve multiple components and channels of communication, and there is much to learn about what characteristics of interventions work with low-income audiences. Hence, a detailed description of the nature and intensity of the various components of a nutrition intervention can enable identification and replication of the promising program elements. Similarly, a description of the target audience, sample size, response rates, and the reliability of measures can help to appreciate the wider applicability of study findings. Reporting should include the mean and variance or distribution of outcome measures for the intervention group and for the comparison group both a baseline and at follow-up.

There is, of course, much to be learned regarding research measures. Nonetheless, the overall sense conveyed by this special issue is that much of what needs to be learned, such as the sensitivity to changes resulting from an intervention, can result from the use of these tools in evaluation studies.

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# System, Environmental, and Policy Changes: Using the Social-Ecological Model as a Framework for Evaluating Nutrition Education and Social Marketing Programs with Low-Income Audiences

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**ABSTRACT** A variety of nutrition education interventions and social marketing initiatives are being used by the Food Stamp Program to improve food resource management, food safety, dietary quality, and food security for low-income households. The Social-Ecological Model is proposed as a theory-based framework to characterize the nature and results of interventions conducted through large public/private partnerships with the Food Stamp Program. In particular, this article suggests indicators and measures that lend themselves to the pooling of data across counties and states, with special emphasis on systems, environment, and public policy change within organizations at the community and state levels.

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## A SOCIAL-ECOLOGICAL MODEL

Sustained improvements in dietary behavior often benefit from long-term, repeated exposure to behaviorally focused nutrition education through a variety of channels and in ways that can compete in today's marketplace.[1–6] These range from small groups that participate in interactive education to large-scale social marketing campaigns. These efforts feature multiple channels of communication, along with system, environmental, and policy change as a way to reinforce healthy nutrition behavior.[7–9] Reviews of research efforts suggest that multiple approaches to health and nutrition education complement one another.[2–6,10–14] However, this range of methods and interventions presents particular challenges for evaluation.

This article presents a theoretical framework for planning and evaluating nutrition education programs with low-income populations. Because it provides a framework for describing individual change within the context of social change, a Social-Ecological Model[15] may provide a conceptual framework that can assist in the planning and evaluation of multiple-component nutrition education programs. This particular model conceptualizes the social world in five spheres, or levels, of influence (Fig. 1). These levels of influence are (1) social structure, policy, and systems; (2) community; (3) institutional/organizational; (4) interpersonal; and (5) individual.

The sections that follow describe each of the five spheres of influence in the Social-Ecological Model as they may be applied to conducting and evaluating large-scale nutrition education programs. A summary of theories and indicators appropriate for each sphere is found in Table 1. Theories and examples of the science-based indicators that can be used to identify and evaluate change in each sphere are described. Indicators are the theoretical constructs, activities, and behaviors that the evaluator would operationalize to identify change at the particular level. Measures are the specific tools (surveys, dollar amounts, etc.) that can be used to evaluate the change; they are described in the sections that follow. This article will concentrate on the broadest three spheres (see Fig. 1) as they pertain to large-scale nutrition education campaigns for low-income consumers. It should be noted that interventions involving the first three spheres may occur at the community, state, or national level. The two innermost spheres (see Fig. 1), interpersonal and individual, are not discussed in as much depth because they are treated in more

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**Figure 1.** A Social-Ecological Model for nutrition evaluation: spheres of influence. From McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. Health Educ Q 1988;15:351–377.

detail in the other articles of this supplement. Also, although nutrition education may ultimately need to be evaluated in terms of the effects of behavioral and dietary change, attention to the effects of nutrition education activities at the system, community, and organizational levels is important because changes at those levels can enable and reinforce changes at the individual level.

**Social structure, policy, and systems sphere of influence.** The broadest level of influence in the Social-Ecological Model is social structure, policy, and systems. This sphere includes local, state, and federal policies that regulate or support organizational or individual behavior, including protection of or attention to children and special populations. Policy includes more than laws and regulations. The Food Guide Pyramid and U.S. Department of Agriculture (USDA) guidelines for nutrition education in the Food Stamp Program are part of this level, and, in turn, they influence entire systems of service delivery and consumer communications. Organizational mission statements, position papers, and industry standards that are enforced administratively or followed voluntarily are other examples of policy decisions.[15]

Policy changes tend to be the culmination of incremental steps. Policy decisions are affected by customs and traditions as well as situational improvisations and political negotiations.[16] Approaches to policy and systems change often include the components of public education, policy-maker education, and advocacy.[17–19] In addition to program-specific process measures, some theories, such as Crespi's summary of the public opinion process, are useful for tracking policy and public opinion change as a measure of the social environment.[18]

***Indicators.*** Indicators of progress for policy change include process measures such as the amount and content of educational outreach by concerned groups and documentation of consistent advocacy over time, as well as descriptions of the political climate of policy makers and their constituents.[19] Small steps such as the development of educational materials geared toward policy makers and of efficient methods of materials distribution are an example of one step of the complex process of policy change. An endpoint indicator of policy change is the policy document itself, such as a copy of a new law, regulation, or position statement; however, focusing only on the end result does not account for development.[19] Should a policy be adopted, it is likely helpful to estimate the size of the population that will be affected.

Changes can also result from interactions among individuals, organizations, and government, as suggested by Crespi.[18] For instance, a community program in Wisconsin worked with the transportation agency to alter bus routes and improve service to local supermarkets in low-income neighborhoods.[20] Similarly, in New Jersey, the nutrition education program

**Table 1.** Sample theories, indicators,[a] and constructs by sphere of influence from the Social-Ecological Model.

| *Sphere of Influence* | *Sample Theories* | *Indicators and/or Constructs* |
|---|---|---|
| Social structure, policy, and systems | Public opinion process[18] | Individual transactions (situational contexts, perceived reality, individual opinions), collectivity transactions (collective opinion, emergent mutual awareness, group context, and roles), legitimation and political transactions (political role of collective opinion, linkages to government), and convergence of these sectors |
| | Policy change process[19] | Outreach and materials dissemination to policy makers, gatekeepers, and constituents; drafting of policy documents; policy adoption; other intermediate steps as relevant |
| | Project change initiative theory of change[21] | Advisory group formation, community training, community organizations, leveraging opportunities, convening and education of stakeholders, public education |
| Community | Social marketing components[22] | Advertising/public service announcements, publicity (free news coverage), promotions, community development |
| | Partnerships[23] | Degree of collaboration, length of partnership, fiscal relationship (Fig. 2) |
| | Community organizing[24] | Empowerment, community competence, participation and relevance, issue selection |
| Institutions and organizations | Social marketing components[22] | Organization-specific advertising, publicity, promotions (see Community above) |
| | Diffusion of innovation[25] | Relative advantage, compatibility, complexity |
| | Organizational change[26] | Problem definition, initiation of action, implementation of change, institutionalization of change |
| Interpersonal | Appropriate social marketing components[22] | Personal sales (nutrition education classes), consumer empowerment |
| | Social Cognitive Theory[1] | Behavioral capability, expectations, self-efficacy, observational learning, reinforcement |
| Individual | Transtheoretical Model (Stages of Change)[27] | Precontemplation, contemplation, decision, action, maintenance |
| | Health Belief Model[28] | Perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action |

[a]Indicators are the theoretical constructs, activities, and behaviors that the evaluator would operationalize to identify change at the particular level. Measures are the specific tools (surveys, dollar amounts, etc.) that can be used to evaluate the change.

negotiated a policy change that allowed the delivery of nutrition education to participants in state employment and training programs,[7] thereby increasing outreach efforts.

***Measures.*** Measures of policy change will generally be descriptive owing to the nature and specificity of what is studied. Two examples of descriptive measures often applied are process measures and narrative case studies.

*Process measures.* A tracking system for measures of long-term policy change might include the number of informational documents created and disseminated to educate constituents, requests from the public for information, requests for state budget appropriations, or the proportion of legislators, employers, or other gatekeepers who received educational information from constituents. Tracking can be useful to review the kinds of messages that are emphasized in advocacy efforts or to whom the efforts are targeted.

*Narrative case studies.* Policy changes sometimes occur suddenly, such as after negative public exposure about a problem. These events may better be described using a narrative case study to capture the more subtle nuances of the political environment. "Suggestions for Writing a Success Story" (Table 2) is a template that can be useful in writing accounts of effective programs. This template is an example of a best-practices summary used by Food Stamp Nutrition Education Programs (FSNEPs) in Wisconsin.[29] Useful measures include information on legislation or regulation that was passed and a description of how passage was secured. This information can be useful to others who want to effect similar changes. Case study research can also be conducted across programs to identify features associated with the implementation of nutrition education programs that deserve closer investigation.[30]

**Community sphere of influence.** The community level includes social networks, norms, and standards that exist formally or informally among individuals, groups, partnerships, and organizations. Community-level theoretical models hold

| Organization Identification | Type of Organization | Depth of Relationship | | | | | Outcomes the Organization Contributes to: | | | | Resources (Est. Dollar Value) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Network | Cooperator | Partner | Coalition Member | Collaborator | Education | Access to Food | Coordination | Public Policy | Indicate Matchability |
| *Name of Organization:*<br>*Address:*<br>*Phone*:<br>*Contact Name:* | | | | | | | | | | | |

**Key for Type of Organization:** Choose a code for each organization and place in column to show the diversity of your collaborations:

1 Government
1A City/county
1B State food stamp
1C State health
1D State education
1E State social services
1F Other state government
1G National government

2 For-profit private sector
2A Food producer or commodities organization
2B Supermarket or food retailer
2C Media (television, radio, print)
2D Other for-profit private sector

3 Nonprofit
3A Churches/religious organizations
3B Food bank/hunger program
3C Hospital/medical care
3D Professional association
3E Service group (e.g., Rotary)
3F Nonprofit commodity association (e.g., Dairy Council)
3G Foundation/United Way
3H Other (*describe)*

4 Schools
4A Preschool
4B Elementary/middle school
4C High school
4D Colleges/universities

5 Other *(describe)*

**Key for Depth of Partnership:**

*Network:* Member of a formalized nutrition education network.

*Cooperator:* Assists with information such as referrals and announcements about classes, provides space for business cards or brochures to be distributed, or has created opportunities to speak about the program to increase community awareness.

*Partner:* Provides a match by providing cash contributions or in-kind match.

*Coalition Member:* Participates in advocacy and public education activities.

*Collaborator:* Contributes to the plan of work and has identified personnel who help advise and make decisions about effective nutrition educational programming with you. Has built an interdependent system that is measuring shared impacts.

**Key for Outcomes the Organization Contributes to:** Indicate all the ways each organization contributes in terms of the following:

*Education:* Provides space, service, or personnel to increase the times and numbers of persons who can be reached by education. Includes space or personnel assisting in education or transportation, child care, donated food, or equipment for education.

*Access to food:* Enables clients to have a better selection of nutritious food. This may be documented by self-report from grocers or other retail establishments; self-report from food management staff, such as nursing home,day care,or school foodservice personnel; pre-/postobservation of food offered in retail stores; pre-/post-observation of nutritious refreshments or snacks available in organizational meetings; community food recovery efforts; increased farmers markets' acceptance of food stamps or electronic benefit transfer (EBT) cards.

*Coordination:* Coordinates actual nutrition messages with your program's messages, coordinates education with other services at the same site, reduces application/eligibility processes for clients.

*Policy:* Has made client support changes in its own policies, encouraged joint policy discussions with other organizations, or encouraged public discussions of current public policies (e.g., Good Samaritan laws) or private policies (e.g., coverage for diabetes education).

**Resources:** Indicate the resources that the partner contributes to nutrition education. Specify both resources counted as a match (and indicate with an asterisk) and total resources (which may include resources that do not count as a match).

**Figure 2.** Partnership profile for system, policy, and environmental change.

**Table 2.** Suggestions for writing a success story.

*What makes a great success story?* As the saying goes, if anything's worth doing, it's worth doing well! This sheet will provide you with tips on how to make your success stories more interesting.

- *Who are the main characters of your story?* If you are writing about children, then pick out a few unique cases in which certain children indicated they had learned from the program. Tell the story of these specific children.
- *Who presented the program?* Don't forget to give credit where credit is due! This includes the person who gave the program as well as the unit with which that person is affiliated.
- *What was learned?* If the main character(s) indicated they learned something from the program, what was it? What did they *not* know before the program that they knew after?
- *How was the program conducted?* Tell how this information was presented. What was unique about the program that caught people's interest?
- *When did the program occur?* Was your program at night? Was your program in the spring?
- *Where was the program held?* Was your program given at the local YMCA? Also, remember to include the name of the county in which the program was held.
- *How many people attended the program?* If 100 8th graders attended your program, say so.
- *What was said?* Stories are more interesting if you can use quotes. Not only quote the main character(s) of your story, but spice things up by including the comments of participants.

Some things to remember as you write your success story:

- *Use examples!* Don't just tell us the seniors were interested in your program; tell us how! Did they laugh? Did they ask a question which showed they were interested? What was the question?
- *Use simple language!* When you write, stick to language that everyone understands. A junior high student should be able to read and understand your story.
- *Use details!* Don't ever assume your reader knows what you are talking about! For example, don't just tell us that a new recipe tasted wonderful; tell us what made that recipe wonderful.

Some things to do after you write your story:

- *Proofread!* Check your work for typing errors. Did you use the correct form of "its/it's" and "your/you're"? Are sentences complete?
- *Read your story aloud!* If your story sounds funny when you read it aloud, then it will sound funny to your reader.
- *Include your name, county, name of program, and telephone number!* We may have questions about your story. Be sure to include the above information so the editors can contact you as needed.

Good luck! And may all your success stories be *great success stories!!!!!*

From Reporting Results section of University of Wisconsin Cooperative Extension Service Website (http://www.uwex.edu/ces/wnep/).

that collaboration is a process of participation through which people, groups, and organizations work together to achieve desired results.[23] Models of community organization emphasize active participation by residents so that communities can better evaluate and solve health and social problems. Organizational change theories examine the process of health and nutrition promotion policies being adopted and institutionalized within formal organizations.

Broad community support for nutrition education creates a more positive environment for behavior change and a shared commitment to improving the nutritional status of members of the local community. Furthermore, the greater the number and variety of community partnerships and the deeper the collaborations with these partners, the greater the learners' access will be to education, nutritious low-priced food, and community recognition of nutritional success. An example of a community-level activity is the Maine Nutrition Network, which has been working with community farmers markets to allow redemption of food stamps to help increase access to low-cost fresh fruits and vegetables by low-income families. Analysis of redemption data found a 15% increase in the dollar value of food stamps redeemed at farmers markets and roadside stands.[7]

***Indicators.*** Community-level models are critical for comprehensive, multichannel health and nutrition promotion programs because they provide a framework for understanding how people interact, how social systems function, and how communities can be mobilized.[23] In communications and marketing, "channels" are simply any means through which persuasive messages are delivered.[22] Indicators of community-level change may include assessments of partnerships,[31] changes in social norms and the community environment, and documentation of social marketing activities (see Table 1).[32]

*Partnerships and coalitions.* The number, type, depth, and strength of partnerships involved in the social marketing of nutrition education efforts can be important indicators of change.[33] The greater the number and variety of community partnerships and the deeper the collaborations among these

partners, the greater will be the exposure of target audiences to social marketing messages and affordable and nutritious food.[33]

The nature and scope of partnerships, such as those formed by programs providing nutrition education to participants in the Food Stamp Program, are indicative of either an empowered or an engaged community. Kretzmann and McKnight asserted that the basic element of community organization is mobilizing communities to create associations and build community capacity to decide on a common problem, share in developing a plan to solve the problem, and take action to implement the problem-solving plan.[34] Other models of community collaboration also propose a continuum of involvement starting with networks and progressing through to cooperation, coordination, and, finally, collaboration.[24,35–39]

*Social norms and the community environment.* The community environment tempers the thoughts, values, mores, and actions of individuals. Social norms are guidelines that govern our thoughts, beliefs, and behaviors.[40] Shared assumptions or norms of appropriate behavior are reflected in everything from laws to expectations and are manifestations of the prevailing social values within a community. In the tobacco control movement, for example, the normative change started in the social environment at the grass-roots, community level.[41] The goal of an effort to change social norms is to create a social milieu and legal climate in which a particular behavior becomes more or less desirable, acceptable, or accessible. One means of influencing norm changes is through community organizing.[42] With skilled leadership, efforts that start at the community level can be transferred to higher levels of government. For example, in Los Angeles, a grass-roots advocacy project assisted groups of parents to assess the nutrition and physical activity situation in their low-income community and take their concerns to their school board and state legislators. As a result, legislation has been introduced proposing significant improvements in schools and communities statewide.[43] In Sacramento, California, advocates and parents were instrumental in the school board's decision to reject a soft drink contract and to initiate a study of the districts' nutrition and physical activity policies (Purcell A, personal communication with second author, September 18, 2000).

*Social marketing approaches: publicity, advertising, and public relations.* Publicity via free news coverage gives visibility to a program, frames the program's issues, and initiates conversation related to those issues. Free publicity, paid advertising, unpaid advertising through public service announcements (PSAs), public relations activities, and news editorial activities can help shape public opinion. Documenting the nature and frequency of these types of media coverage can indicate the importance of an issue to community members.

Specifically, publicity has been described as advertising, informational messages, and promotional events,[25] but conceptualizing it as free coverage in print and electronic media to distinguish it from other types of advertising has also been an effective approach for planning and evaluating large-scale social marketing programs.[26] Paid and unpaid advertising, or PSAs, for electronic media are usually conceptualized as radio and television commercials.[44] In the print medium, both paid and unpaid advertising can appear outside the home, such as on billboards, on transit (e.g., buses), or in newspapers.[44]

Public relations is news and news media outreach activities about an issue or service that is not guaranteed to appear in print or electronic media but is likely to appear if the topic is newsworthy enough.[27] Public relations activities are conducted to shape the content and type of news coverage.[28] Public relations includes press conferences, community events covered by the media, media tours with trained spokespersons, deskside briefings, visits with editorial boards, feature articles, and the creation of educational materials for media use.

Media promotions are often conducted using a combination of social marketing components. Spanish-language outlets in California, for example, employ multiple marketing elements, such as on-air promotion, live remotes, billboards, airing of PSAs during premium air times, preferential coverage during public affairs segments, interviews with media spokespersons, and tie-ins with station and community events to get health messages to the public.[45] In Kent County, Michigan, a multimedia nutrition education campaign combined cable television advertisements, billboards, bus posters, newsletters, and take-home information on the back of school menus. This 3-month local campaign achieved higher unaided recall of related media messages in low-income neighborhoods than the national "Got Milk?" campaign, which had been airing for more than a year.[46] The Kent County campaign specifically targeted low-income families, and aided recall of the nutrition campaign was significantly greater among households with incomes below $20,000 than among higher-income households (52% vs. 40%, $p < .05$).[46] This suggests that carefully executed nutrition education media campaigns can effectively target low-income populations.

***Measures.*** Measures at the community level include measures of partnerships among organizations involved or interested in nutrition education efforts, measures of social norms of the community environment, and measures of social marketing activities.

*Partnerships.* Measures important to assessing change in partnerships include the actual number and types of organizations in a partnership, the depth of relationship between and among partners, time and resource contributions by each partner, and the fiscal resources leveraged by each partner.

Scales describing the depth of collaboration within partnerships build on work in community development.[37,38] There is some evidence nationally from 22 nutrition education networks[7] and from community-based programs in Illinois and Wisconsin[33] that state or county nutrition networks with deeper degrees of partnership launched more extensive social marketing programs than networks with weaker partnerships. As shown in Table 3, progress over time can be monitored in terms of the number and type of partners, the depth of partnerships, and the types of contributions that partners make toward a social marketing effort in nutrition.

**Table 3.** Depth of relationship of nutrition partners.

| *Type* | *Depth of Organizational Relationship* |
|---|---|
| Network | Organization has signed on as a member of a formalized nutrition education network, such as those supported by USDA. There is ongoing dialogue and information sharing. |
| Cooperator | Organization assists with information such as referrals, announces classes, provides space for brochures, and provides access to clients to increase community awareness. The goals of this relationship are to ensure that work is done. |
| Coordination or partnership | Organization maintains autonomous leadership, but there is a common focus on issues and group decision making. The emphasis in this relationship is on sharing resources to create something new. |
| Coalition | Organization has longer-term commitment to joint action in the area of nutrition education. Leadership is shared, roles are defined, and new resources are generated. |
| Collaboration | Organization contributes to joint nutrition activities and has identified personnel who help advise and make decisions about effective educational programming. An interdependent system is built to benchmark shared impacts. Consensus decision making and formal links and role assignments are common. |

From Reporting Results section of University of Wisconsin Cooperative Extension Service Website (http://www.uwex.edu/ces/wnep/).

Contributions to the partnership relationship may focus on improving education, access to food, or public policy. The approximate dollar value of resources can include in-kind contributions—both in-kind contributions from governmental agencies used as state match and in-kind contributions from private organizations.

The authors of this article helped adapt a partnership profile, originally developed by the National Collaboration Network and revised by Wilson.[33] It summarizes the nature and scope of partnerships in a community and provides a standardized way to assess progress in developing nutrition promotion partnerships in communities, states, and the nation (Fig. 2). Collection of these data over time can help describe changes in maturation of partnerships, in access to nutrition education, and in allocation of resources (e.g., in-kind monies that are eligible for match vs. other in-kind monies). This type of measurement tool can show where partnership efforts should be targeted to yield the most benefit.

The partnership profile grid (see Fig. 2) was used in 1998 with 2600 community partners in the Wisconsin and Illinois nutrition education programs.[33] This qualitative study examined the depth of relationships among participating extension units and organizations. The Wisconsin program, which had been operating longer than the one in Illinois, had many more collaborators. Organizations participating for 2 or more years in Illinois and 3 or more years in Wisconsin were significantly ($p \leq .05$) more likely to provide access to food than organizations that had not participated as long.[33] The results of this study indicate that organizations participating at the partnership, coalition, and collaboration levels of maturity provide significantly ($p \leq .05$) more monetary contributions per organization than those with less integrated partnerships.[33] These findings suggest that the investment in long-term relationships has very real benefits.

In addition to gathering data on the strength of organizational relationships in a structured format such as the partnership profile, partners and programs can prepare qualitative narratives, data from which can be used to construct case studies of community action. Qualitative data are useful for explaining the why or how of research questions and can complement data collected in the partnership grid by clarifying how the partner collaboration developed and its perceived effect on a target audience. Case studies can focus on the partnership and program development and include specific documented changes in policy and behavior. For example, a case study may describe a program that has been very effective in reaching the elderly food stamp audience, detailing how the program formed partnerships with the Department of Aging to involve more participants in planning and food preparation of Title III© senior meals. Case studies allow sharing of lessons with other states and communities to help increase overall program impact.

*Social norms and the community environment.* Measures of social norms can be both quantitative and qualitative. Measuring the community environment can emphasize geographic and social features that could influence specified outcomes. Perceptions of the structure of the community environment can be measured in surveys of community members and opinion leaders.[8] Environmental assessment, such as community mapping or site observations, can measure how the community is structured to promote or inhibit behaviors.[15,16] For example, mapping bus routes and supermarket locations, in comparison to major housing sites, provides a way to measure societal structures that can influence nutrition. The social community environment can be assessed from a community organizing perspective that considers community competence, empowerment, participation in issue selection, and raising of critical consciousness.[24]

*Social marketing components: publicity, advertising, and public relations.* Because so many social marketing activities are implemented through the community, it is often a challenge to measure small-scale community-level or nonprofit-initiated campaigns in the same way as larger-scale commercial marketing. (Publicity in social marketing can be operationalized as the general amount of free news coverage that a program receives.) Advertising in a social marketing cam-

paign can include PSAs and paid advertising on television or radio. Commercial statistics of the viewing/listening audience for each media outlet are presented in measures known as media impressions, which estimate how many opportunities there were to see or hear a message.[44] Commercial monitoring can also be used to estimate the level of exposure achieved by a nutrition education campaign in terms of "reach," the proportion of a target audience that actually saw or heard a message, and "frequency," the number of times members of a target audience saw or heard a message.[25,44]

Public relations can be news oriented but supplemented by promotions or contests. Public relations through news outlets can be tracked by the number and nature of press releases or interviews. Electronic news coverage can be quantified by seconds of airtime and the dollar value estimated from the amount of coverage. Print news can include the number of news articles, inches of column space, and estimated circulation of the newspaper. Public relations activities with the public, such as giveaways, are measured in "hits" (e.g., the estimated number from the amount of materials disseminated) and reach.

**Institutional/organizational sphere of influence.** The institutional/organizational level includes factors that influence organizational behavior in the private, public, and nonprofit sectors. Organizations or channels include businesses, schools, churches, public agencies, service organizations, and professional or trade associations that have common policies and procedures and reach large population segments. It is also at this level that many research-based intervention programs are available for settings such as worksites, schools, churches, and grocery stores. Examples of institutional-level programs include North Carolina's Black Churches United for Better Health Research Project.[47,48] A number of African-American churches in California adapted methods from the Black Churches Project and added interventions dealing with the media and public relations, farmers markets, buying clubs, food pantries, after-school programs, and community outreach.[48] Also, in California, 10 retail chains worked with their competitors through the state health department to conduct seasonal 5 A Day promotions targeted to low-income shoppers in more than 1500 supermarkets and grocery stores.[49] A community-based program in the Washington Heights area of New York City worked to persuade local groceries to stock low-fat milk in conjunction with a nutrition education effort to promote the use of low-fat dairy products.[50] Depending on the organization that is targeted by an intervention and the type of intervention, theoretical models such as Diffusion of Innovation[51] and Theories of Organizational Change[52] may be applied at this level of influence. The social marketing components applicable to this level include advertising, publicity, and promotions.[32]

***Indicators.*** Indicators of institutional or organizational behavior change include adoption of new programs and policies and the effectiveness of new programs and policies. Institutional behavior can include activities that occur within an institution and the rules, regulations, policies, and informal structures that govern the behavior of people within the institution. Theories of institutional behavior often focus on the adoption of new programs. Many of these can be tracked through process measures such as documenting organizational efforts toward working with a nutrition program to promote its message by building awareness (Initiation of Action, Organizational Change Theory[52]), modifying the institution's physical environment related to food and exercise (Implementation of Change, Organizational Change Theory[52]), and adopting policies that intentionally promote objectives of nutrition education in the Food Stamp Program (outcomes, Organizational Change Theory[52]).

Indicators of program effectiveness at the institutional level are usually specific to the intervention being tested. An example of an outcome evaluation of an institution-level program is evaluation of a retail grocery store promotion featuring interactive kiosks in the produce section of supermarkets serving low-income populations in Arizona and California. This evaluation measured the percentage increase in produce sales and found significant increases in purchases of fruits and vegetables during the months the kiosks and interactive promotions were used compared with the months when they were not.[49] This study demonstrated the effectiveness of the interactive promotions in increasing produce sales.

Indicators of social marketing activities at the institutional level are similar to those used at the community level and include advertising, publicity, and promotions. These social marketing components can be implemented at the institutional level and be part of larger health promotion projects. Documentation of the number of nutrition education events or promotions and feedback from participants, gatekeepers, and intermediaries are other possible approaches to program evaluation at this level.

***Measures.*** A wide variety of methods and measures can be used to monitor institutional change in research settings.[5] Practical measures of program adoption in applied settings tend to be process oriented and can be guided by constructs of institutional behavior theories. For example, the constructs of Organizational Change[52] can be operationalized as steps toward an institutionalized program. Other examples of channel-specific measures for adoption include assessing the number of farmers markets that accept food stamps or EBT cards or the number and amount of participation in food safety training for volunteers working at local food pantries. Measures of program effectiveness should be specific to the evaluation question, but important questions to ask are whether the program changed dietary intake behavior, purchasing behavior, food safety behavior, or some other behavioral outcome. For example, institutional behavior change measures of effectiveness for implementing EBT cards at

farmers markets would be the rate at which the markets adopted and the rate at which people used them.

Measures of the social marketing components can include documenting the number of locations and prevalence of cues to action at point-of-choice locations (advertising), displays and demonstrations (public relations), and price promotions such as sales, in-store managers' specials, and cents-off coupons (promotions). The number of geographic locations and descriptive statistics of program activities will provide estimates of the reach of an intervention. Measures of implementation are important to programs, but measures of outcome should also be assessed when feasible.

**Interpersonal sphere of influence.** The interpersonal level of influence includes primary groups, such as peers, family, and friends, that provide social identity, support, role delineation, and interaction for an individual.[15] Individuals exist in a dynamic social environment in which the attitudes and actions of others influence an individual's behavior. Examples of theories at the interpersonal level include Social Cognitive Theory, which posits that people and environments continuously interact to form social meaning.[1] The social marketing component (most likely to be applicable) is the delivery of one-on-one or small-group nutrition education.

***Indicators.*** Assessment of individual attitudes and other variables based on the constructs of Social Cognitive Theory or other interpersonal level theories can be used to indicate program effectiveness. Constructs of Social Cognitive Theory that could be measured include behavioral capability (the knowledge and skills to influence behavior), expectations (the beliefs about the likely results of actions), self-efficacy, observational learning, and reinforcement.[1] Indicators of interpersonal influence include the type and quantity of nutrition education that is delivered.

***Measures.*** Interpersonal indicators are commonly measured by surveys, which may be designed for statewide monitoring, targeted to a specific population, or incorporated into program evaluation forms. Survey questions may be designed to assess an individual's interaction with others or the perception of the immediate social environment. Repeated surveys can measure changes over time. Specific examples of survey items are "I eat fruits and vegetables because I want to set a good example for my family" (modeling) and "There are a lot of fruits and vegetables I don't know how to fix" (behavioral capability). Survey items like these, combined with dietary assessment, help monitor the intermediate effects of a program.

On a direct service level, the reach of a program can be assessed by monitoring the types, amount, consumer attendance, and geographic distribution of materials and the number of people contacted through these materials and programs. Tracking total classes offered or attendance can quantify the educational interaction. Assessing the content of curricula and messages will determine which messages are most frequently promoted and identify reasonable expectations for program effectiveness. Instruments may include peer educator logs, descriptive reports of intervention activities, attendance counts, and key informant interviews with opinion leaders or gatekeepers.

**Individual sphere of influence.** The individual level is the most specific level of influence. This level focuses on expressed behavior choices and psychological and cognitive factors such as knowledge, attitudes, beliefs, and personality traits. Measurement can be informed by theories that examine behavior change at the individual level, such as the Transtheoretical Model, commonly called Stages of Change,[53] which has been used by state nutrition programs, such as the Maryland Special Supplemental Nutrition Program for Women, Infants and Children (WIC),[54] to develop targeted consumer messages. Other theories that focus on the individual tend to be rational choice models, such as the Health Belief Model.[55] A large amount of health education research has focused on the individual, and numerous other theoretical foundations that are appropriate for this level are in the published literature.

***Indicators.*** At the individual level, indicators reflect the cognitive decisions and thought processes that occur within the mind of an individual (such as knowledge, beliefs, attitudes, cues to action, perceived barriers and benefits) and that are associated with an individual's behavior. The Transtheoretical Model identifies five stages of psychological readiness to adopt a new behavior, ranging from precontemplation (not aware of the need to change) to "maintenance" of a behavioral change over time.[53] Typically, the stage of readiness is identified through an initial assessment and then used to tailor intervention messages, materials, and skill building to the individual. Other examples of attitudinal indicators from Social Cognitive Theory or the Health Belief Model include perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cues to action.[55] When applied to nutrition education, one, some, or all of these indicators can be useful for understanding the individual's perceptions of food, nutrition, and disease, depending on the program focus and available resources.

***Measures.*** Individual indicators are readily measured by surveys, interviews, or other assessments of individual behavior. Operationalizing a theoretical construct in a survey question or a module of questions is one way of assessing that construct in an empirical manner. For example, the Maryland WIC 5 A Day Program used a survey question module to determine an individual's stage of readiness for eating five or more fruits and vegetables a day and for eating two or more servings a day.[54] In California, an item on the California Dietary Practices Survey[56] to determine perceived severity of a poor diet is "What I eat or drink will not make any difference in whether or not I get cancer."

Although antecedents to behavior can be easier to assess, behavioral change itself is the ultimately desired outcome of nutrition education programs, including the behaviors associ-

ated with food resource management, food safety, dietary quality, and food security. Behavioral antecedents can provide early indicators of program effectiveness. However, evaluations are typically most persuasive when they demonstrate changes in actual behavior. Telephone and self-administered surveys can often be used to gather information. The efficiency of these methods and the ability to replicate them across large populations can make them an attractive method of data collection. However, the reliability and validity of measures should be considered when designing survey data collection from low-income populations. Qualitative research approaches, such as group or individual interviews, may also be used to gather more in-depth data than are available from a survey.

## IMPLICATIONS FOR RESEARCH AND PRACTICE

The magnitude of social and environmental change needed to make and sustain healthy eating and a physically active lifestyle can be profound, and the challenge of eliminating disparities experienced by low-income individuals can be even more daunting. System, environmental, and policy changes at local, state, and national levels may occur slowly, but research from tobacco control suggests that attention to these levels of influence is necessary when individual and interpersonal behaviors are not enough to overcome negative environmental influences.[8] Since such changes make healthier living easier for large numbers of people, they are also very efficient and ultimately may be the only way to sustain healthful environmental and behavior change in a dynamic, competitive marketplace environment.

Historically, nutrition policy has been driven at the national rather than state or local level, so there is relatively little experience and a very small body of literature dealing with factors and strategies that influence systems and environmental and policy change at the state and local levels. For this reason, as well as the urgency of correcting widespread nutrition and physical activity problems, nutrition education in the Food Stamp Program is addressing promising areas of intervention activity. Applying an integrative framework such as the Social-Ecological Model in a disciplined manner holds tremendous potential for assessing the effects of nutrition education and social marketing activities, improving the quality of programs, and accelerating needed public health change. This will be especially critical if it turns out, as it did for tobacco control, that diverse local community projects become the engine of larger-scale change.[41]

That said, evaluating programs from a social-ecological approach presents a number of challenges. It will be important to assess the reliability, validity, and ease of data collection within each of these levels of influence. A particularly exciting research challenge will be to understand the relationships and capture the synergy among the various levels. For instance, although it is logical to think that nutrition partnerships promote system, environmental, and policy change and assist in the delivery of nutrition education, their potential for fostering change is not yet known. When quantitative data are available, statistical approaches that can examine one component nested within a larger component, such as hierarchical modeling or network analysis, may be particularly useful for understanding the relationships between levels.

Exploring the possibilities for evaluating multilevel programs through the Social-Ecological Model is the first step toward developing a universal reporting system that will provide comparable data from different states related to each level of the model. The next step will be the challenge of developing ways to synthesize information from multiple sources to draw conclusions that are broad enough for generalization yet specific enough to be useful to federal, state, and community stakeholders.

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# Food Shopping Practices Are Associated with Dietary Quality in Low-Income Households

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**ABSTRACT** Nutrition education for low-income audiences often focuses on building skills in food shopping and food resource management to help families receive the best nutrition from the resources they have available. However, empirical evidence for the effect of food shopping practice on dietary quality has been limited. This article presents new analyses from two studies that found an association between food shopping practices and diet quality. Logistic regression of data from 957 respondents from the 1996 National Food Stamp Program Survey found that food shopping practices were significantly ($p \leq .05$) associated with the availability of nutrients in the food the households used during a week. Similarly, analysis of baseline data from 5159 women from selected counties of states who participated in the Expanded Food and Nutrition Education Program found that food shopping practices were significantly ($p \leq .05$) associated with increased consumption of nutrients as measured through a single 24-hour recall. These findings suggest that food shopping practices are an important area for nutrition education with low-income audiences.

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## INTRODUCTION

Food shopping practices are an important aspect of food resource management. Food resource management may be described as the handling of all foods and resources that may be used to acquire foods by an individual or family. After planning, food shopping is the next link in the chain leading to food consumption, preceding the activities of food storage, preparation, and service that may further affect nutrient values.[1,2] Food shopping practices are often one focus of nutrition education efforts to help low-income families extend their food dollars and to help people make healthy food choices.[3] Accordingly, valid and reliable measures of food shopping practices could help in evaluation of nutrition education programs. However, empirical data for the relationship between food shopping practices and diet quality have been limited. Indeed, several researchers have questioned whether we adequately understand the types of food shopping practices that are useful for low-income families given the constraints that they face.[2,4,5]

Low-income families frequently confront constraints—such as a lack of nearby supermarkets, limited selection in nearby stores, lack of transportation to stores of their choice, lack of child care, and limited time to do food shopping—that can make food shopping skills particularly important.[2,4–7] A 1995 U.S. Department of Agriculture (USDA) study, which analyzed the type and geographic distribution of all 200,000 Food Stamp Program (FSP) authorized food retailers, found that about 40% of the rural population resided in localities without a supermarket or large grocery store.[8*] In

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*Classifications were made based on gross sales; supermarkets had gross sales over $2 million, and large grocery stores had gross sales of $500,000 to $2 million.

urban areas, the average number of supermarkets in high-poverty areas (0.9 supermarkets) was somewhat less than in low-poverty urban areas (1.14 supermarkets).[9] Moreover, the supermarkets in high-poverty urban areas tended to offer fewer full-service departments, less brand choice (5%–10% less variety in brands and in package types), and less choice of fresh fruits and vegetables.[9,10] A USDA survey of food items and prices in a sample of 2400 stores in 1995 found that supermarkets offered a wider variety of foods at considerably lower costs than other types of stores: compared to supermarkets, the average market basket costs 33% more in small grocery stores and 50% more in convenience stores.[9] The higher costs in neighborhood and convenience stores were much more pronounced for high-margin items such as candy and soft drinks than for basic commodities such as milk, eggs, and potatoes. Thus, shoppers who use smaller neighborhood grocery stores may need to be especially alert to the costs of nonstaple items.

Nutrition education efforts need to recognize the pressures that influence food shopping practices in low-income families. For instance, Morton and Guthrie's analysis of 1879 women (including 658 women with children) in the 1994 Continuing Survey of Food Intakes by Individuals (CSFII) assessed women's perception of factors that influenced food purchasing decisions.[5] In making food purchasing decisions, lower-income (<130% of poverty) women with children were significantly more likely than higher-income women with children to rate as important how well the food keeps (75% vs. 53%, $p \leq .05$), the price of food (71% vs. 36%, $p \leq .01$), and the ease of preparation (42% vs. 32%, $p \leq .05$).[5] Lower-income women with children were significantly less likely to use the nutrition label when buying food than higher-income women with children (61% vs. 68%, $p \leq .05$). The authors concluded that nutrition messages must be realistic about the limited means and competing concerns of low-income consumers when attempting to improve their shopping practices.

These issues could affect the types of shopping practices low-income families are able to employ. Dinkins's[4] analysis of the 1993 Marketing Research Corporation of America survey of 5550 respondents compared the food shopping practices of households with a strict versus a nonstrict budget based on agreement with the item "I run my household on a strict budget." (Although the study was not restricted to low-income households, 27% of study respondents had annual household incomes of <$20,000.) The survey found that households with strict budgets were significantly less likely than households with nonstrict budgets to make a complete list before going shopping (20% vs. 32%, $p \leq .01$), shop around for food bargains (14% vs. 25%, $p \leq .01$), use coupons (10% vs. 14%, $p \leq .05$), or stock up when they found a sale on the brand of food items they like (5% vs. 9%, $p \leq .05$). In interpreting these findings, Dinkins speculated that having a strict food budget may compel households to limit their purchases to required items so that shoppers may perceive little need for a shopping list and may be more concerned about current cost than about long-term savings.

On the other hand, at least one study among low-income women found a relationship between food shopping practices and dietary outcomes. A study of 95 women (78 who received a 6-hour education program and 19 women in a comparison group) found that, at baseline, the frequency with which women reported using the Nutrition Facts panel on the food label to choose foods was positively associated with vitamin A ($r = .41$, $p \leq .01$), carotene ($r = .43$, $p \leq .01$), calcium ($r = .23$, $p \leq .05$), and servings of fruit consumed on 3 days of dietary recalls ($r = .23$, $p \leq .05$).[11] In general, however, there is relatively little evidence for the relationship of specific practices to dietary outcomes with low-income populations. The analyses of the studies that follow are intended to help address these gaps.

## METHODS

To investigate the possible contribution of food shopping practices to dietary quality, the authors of this report analyzed self-report food shopping practice checklist data from two studies with low-income populations: (1) the 1996 National Food Stamp Program Survey (NFSPS)[9,10] and (2) 1998–99 data from the Expanded Food and Nutrition Education Program (EFNEP) Evaluation/Reporting System (ERS).[12]

**Analysis of NFSPS data.** The 1996 NFSPS gathered data on food shopping practices from a stratified random national sample of 2142 FSP participants.[9,10] Analyses of the relationship between food shopping practices and diet were conducted with a randomly selected subsample of 957 food stamp households that completed a 7-day food use record.[10†] A week before completing the 7-day food use record, survey staff met with the respondent to explain the record-keeping task, working through examples of a grid for recording foods used each day and providing a plastic envelope in which to keep grocery receipts and food labels. As soon as possible following the 7-day period, usually within 24 hours, an interview was conducted to review the food use record. The interview employed a detailed-assisted recall process that was structured according to major food categories. The interview was usually done in the respondent's kitchen to allow the respondent to refer to packages and containers when supplying information. These food use data included all food prepared for use at home including food taken from home supplies but not actually eaten, such as waste in cooking and plate waste. Hence, the 7-day food record in the NFSPS measures food disappearance rather than food consumption.

[†]A comparison found no significant ($p \leq .05$) differences in the household size, in household income,[10] or in the frequency of engaging in specific food shopping practices between the 957 respondents in the subsample who completed the 7-day food use record and the full sample of 2142 FSP participants.

Accordingly, the term "food availability," rather than "food intake," is used to refer to this measure.

The primary dependent variable in these analyses was the percentage of households whose nutritional availability fell above or below the threshold of 100% Recommended Dietary Allowance (RDA) for nutrient intake. The Food Intake Analysis System, developed by the University of Texas at Houston, was used to convert food availability data to nutrient availability data.[10] The study estimated whether the nutrient availability of a household during the observation week met the 100% RDA levels during the observation week for eight different nutrients: vitamin $B_6$, folate, protein, vitamin A, vitamin C, calcium, iron, and zinc.[10]

The nutrient availability measure used in the analysis adjusted for household size and household composition as well as meals eaten outside the home. This was done by computing equivalent nutritional units (ENUs) to normalize the household size for the nutritional requirements of household members. The ENU measure scaled the energy requirements (based on the RDAs) of each family member in relation to the food energy requirements of a 30-year-old adult male (adult-male equivalents). For instance, a 30-year-old male has a food energy RDA of 2900 kcal per day, whereas a 30-year-old woman has an RDA of 2200 kcal. Therefore, a married couple in their thirties with no children would have an adjusted household size of 1.76. The measure also adjusted for nutrition requirements based on the age and gender of household members (e.g., women have a higher RDA for calcium, relative to food energy, than men).

The nutrient availability measure was also adjusted for the proportion of meals eaten by each member at home. For example, if half of the meals of a household member were eaten at home, then in computing ENUs, that member's contribution would count only half as much to ENU household size as it would if all of the meals had been eaten at home. (In practical terms, however, this adjustment was modest; in the NFSPS, 85% of meals were eaten at home.)

The use of these ENU adjustments therefore contributes to a more accurate estimate of the relationship between food shopping practices and food availability because the adjustment helps to control for differences in household size, household composition (and resulting differences in RDAs by age and gender), and the proportion of meals eaten in the home.

The independent variable in these analyses was a food shopping practice checklist about the frequency (i.e., "never," "only," "occasionally," "fairly often," or "pretty much every time") with which the primary shopper in the household used six commonly encouraged food shopping practices: (1) look for grocery specials, (2) use a shopping list, (3) stock up on bargains, (4) comparison shop, (5) use coupons, and (6) shop in different stores for specials. For simplicity, this article refers to these practices as "careful food shopping practices." Although these careful food shopping practices have not acquired "recommended" status, they are frequently covered in nutrition education classes with low-income audiences.[13,14] In addition to looking at these individual shopping practices, the analysis created an index of the frequency with which respondents engaged "pretty much every time" in more than one of these practices. For this analysis, we classified the sample into two groups: those participants who reported engaging in three to six careful food shopping practices "pretty much every time" (48.4%) and those participants who reported engaging in fewer than three careful shopping practices "pretty much every time" (51.6%).

Survey data analysis (SUDAAN) software[15] was used to calculate the weights, estimate the variances associated with the survey sampling design, and apply the correct variances in survey analyses. Analyses described the frequency with which FSP participants participated in various food shopping practices and the Pearson correlation among items. A Cochran-Mantel-Haenszel chi-square test, which accounts for the survey design effects,[16] was used to determine if the food shopping practices of the primary shopper were significantly ($p \leq .05$) associated with whether a household met 100% of the RDA level for the specified nutrient. For each dependent variable, multiple logistic regression was used to estimate an odds ratio for the degree of engagement in careful shopping practices, adjusting for household size and poverty status.

The primary statistic used in our regression model to estimate the strength of association between meeting 100% of the RDA and the degree to which households engage in careful food shopping practices was the odds ratio. This ratio reflects the probability of a household meeting 100% of the RDA given a high degree of engagement (three to six) in careful shopping practices compared with the probability of a household meeting 100% of the RDA given a low degree of engagement (zero to two) in careful shopping practices. When there is no difference in the probabilities of meeting 100% of the RDA levels between the two levels of engagement in careful shopping practices, the odds ratio equals 1.0. Therefore, a 95% confidence interval (CI) that contains 1.0 suggests that the differences are not statistically significant at the $p \leq .05$ level. For example, a CI of 1.34 to 2.47 would indicate statistical significance, whereas a CI of 0.87 to 1.22 would not because this spread includes 1.0.

**Analysis of EFNEP data.** The EFNEP ERS Food Behavior Checklist comprises 10 questions designed to evaluate aspects of food resource management, food safety, and nutrition practices.[12] Each question is answered using a 1- to 5-point scale, where 1 is "do not do," 2 is "seldom," 3 is "sometimes," 4 is "most of the time," and 5 is "almost always." Most programs administer the Food Behavior Checklist when participants enrol and again when they graduate (a pre/post model). This study focused on six items of the Food Behavior Checklist related to food shopping practices and food resource management: "How often do you… (1) think about healthy food choices, (2) plan meals ahead, (3) shop with a grocery list, (4) compare prices before buying food, (5) use

Nutrition Facts on the food label to make food choices, and (6) run out of food before the end of the month?"‡

Fiscal year 1999 data from individuals were contributed by counties in four states, each of which was recommended by USDA program staff because of their geographic diversity and the completeness of their data: Virginia (47 counties), Colorado (7 counties), Oklahoma (7 counties), and South Dakota (7 counties). The 5159 nonpregnant and nonlactating adolescents and women between the ages of 12 and 50 in these files were selected for these analyses. Ten percent of these women were aged 12 to 20, and 19% were aged 40 or older. Most of these women (79%) lived with children, and 20% of these women had families of five or more. Two-thirds of the sample had a household income of less than $500 per month (excluding the value of food stamps).§

The 24-hour recall data were analyzed using the EFNEP ERS, version 4,[12] which provided information about nutrients (grams of fat, protein, and fiber) and consumption levels of vitamin A, vitamin C, vitamin $B_6$, calcium, and iron. Although both baseline and exit data were provided by these four states, this analysis focused on the baseline data because baseline data are unlikely to be influenced by the EFNEP intervention. Analyses using SAS software (version 6.12)[17] looked at the Pearson correlation among items and used cross-tabulations and a chi-square test at the bivariate relationships between the food behavior checklist items and consumption of RDAs for specific nutrients.

‡The ERS Food Behavior Checklist also includes two additional items on nutritional practices, "How often do… (7) you prepare foods without adding salt, (8) children eat within 2 hours of waking up?" and two items on food safety, "How often do you… (1) let foods sit out for more than 2 hours and (2) thaw frozen foods at room temperature?" These four items showed weaker correlations to the other six questions and are not discussed here because they are not directly relevant to the topic of food shopping. In addition, the ERS contains a pool of optional questions from which states may choose.

§EFNEP is allowed to serve low-income families who do not receive food stamps. Although data files did not indicate food stamp participation, state EFNEP coordinators indicated that nearly all of these women received food stamps.

## RESULTS

**Findings from the NFSPS.** Analysis of 2142 respondents in the 1996 NFSPS provides a description of the shopping practices of food stamp households[10] (Table 1). In about half of the food stamp households, the principal shopper reported "pretty much every time" looking for grocery specials (51%) or using a shopping list (50%). Somewhat fewer than half reported that they "pretty much every time" stocked up on bargains (42%), engaged in comparison shopping (41%), or used coupons (41%). Only 18% "pretty much every time" shopped in different stores for specials. Food stamp households above and below 75% of the poverty level reported similar practices, except that households below 75% of the poverty level were significantly ($p \leq .05$) less likely to report "pretty much every time" using a shopping list (47% vs. 56%). In all instances, a significantly ($p \leq .05$) higher proportion of food stamp households engaged in careful shopping practices than a national sample of all households based on a 1998 Food Marketing Institute survey[18] (see Table 1). For instance, 51% of FSP participants but only 31% of all U.S. households looked for grocery specials "pretty much every time."

**Table 1.** Food shopping practices of Food Stamp Program participants (%).[a]

| *Food Shopping Practice* | *Total Food Stamp Participants (n = 2142)* | *Below 75% of Poverty (n = 1270)* | *Above 75% of Poverty (n = 777)* | *All U.S. Households (N = 1000)* |
|---|---|---|---|---|
| Look for grocery specials | 51.4 | 51.7 | 51.1 | 31 |
| Use a shopping list | 50.1 | 47.2[b] | 55.6 | NM |
| Stock up on bargains | 42.3 | 44.1 | 39.2 | 24 |
| Comparison shop | 41.1 | 42.3 | 39.5 | 19 |
| Use coupons | 40.5 | 40.0 | 41.9 | 23 |
| Shop in different stores for specials | 17.6 | 19.7 | 14.3 | 6 |

[a]The table shows the proportion of respondents who reported using these food shopping practices "pretty much every time." Total sample size for Food Stamp Program participants is somewhat larger than for participants broken out by income because not all respondents provided complete income information.

[b]Difference between income groups statistically significant using a chi-square test at $p < .05$.

NM = not measured.

Sources: Research Triangle Institute analysis of the 1996 National Food Stamp Program Survey. All U.S. Households: Food Marketing Institute (Trends in the United States: consumer attitudes and the supermarket, 1998, Table 30).[18]

**Table 2.** Pearson correlation coefficient matrix for careful food shopping practices among Food Stamp Program participants.[a]

| *Food Shopping Practice* | *1 Look for Grocery Specials* | *2 Use a Shopping List* | *3 Stock Up on Bargains* | *4 Comparison Shop* | *5 Use Coupons* | *6 Shop in Different Stores* |
|---|---|---|---|---|---|---|
| Look for grocery specials | 1.000 | | | | | |
| Use a shopping list | .280* | 1.000 | | | | |
| Stock up on bargains | .289* | .167* | 1.000 | | | |
| Comparison shop | .384** | .148* | .353** | 1.000 | | |
| Use coupons | .595***. | .273*** | .298** | .308** | 1.000 | |
| Shop in different stores for specials | .323* | .144* | .315** | .540*** | .290*** | 1.000 |

*p ≤ .05; **p ≤ .01; ***p ≤ .001.

[a]n = 953 Food Stamp Program participants.

Source: RTI analysis of the 1996 National Food Stamp Program Survey.

The Pearson correlations among these food shopping practices are shown in Table 2. Although all of these relationships were statistically significant ($p \leq .05$), the strongest correlations were between "looking in the store for specials" and "using coupons" ($r = .59$, $p \leq .001$) and between "comparison shopping" and "going to different stores for specials" ($r = .54$, $p \leq .001$).

Bivariate analyses found significant ($p \leq .05$) relationships between engaging in specific shopping practices and the availability of 100% RDAs in the household, where nutritional availability refers to the nutritional availability at the household level at or above the 100% RDA (Table 3). Food stamp households in which the primary shopper "pretty much every time" looked for grocery specials were significantly more likely than other food stamp households to meet 100% RDAs for vitamin $B_6$ ($p \leq .05$), folate ($p \leq .05$), vitamin A ($p \leq .05$), vitamin C ($p \leq .05$), iron ($p \leq .05$), and zinc ($p \leq .05$). Likewise, food stamp households were significantly ($p \leq .05$) more likely to meet 100% of the RDAs if the primary shopper "pretty much every time" used coupons, used a shopping list, or engaged in comparison shopping (see Table 3). No statistically significant ($p < .05$) associations were observed for stocking up on bargains or for going to different stores for specials.

Next, the analysis investigated whether a combination of careful shopping practices, rather than any specified shopping practice, was associated with household nutrient availability.

**Table 3.** Relationship between engaging in careful food shopping practices "pretty much every time" and meeting 100% recommended dietary allowance (RDA) for households participating in the Food Stamp Program.

| *RDA* | *Look for Grocery Specials (n = 953)* | | *Use "Cents Off" Coupons (n = 955)* | | *Stock Up on Bargains (n = 955)* | | *Comparison Shop at Different Supermarkets (n = 953)* | | *Go to Different Stores for Specials (n = 955)* | | *Use a Shopping List (n = 957)* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No[a] | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes |
| Vitamin $B_6$ | 59.4[a] | 70.9** | 60.5 | 72.1* | 62.9 | 68.4 | 62.2 | 69.9* | 64.0 | 70.9 | 61.9 | 68.9 |
| Folate | 76.0 | 82.2* | 75.5 | 84.4** | 77.6 | 81.0 | 78.0 | 80.9 | 79.0 | 80.0 | 75.6 | 82.9* |
| Protein | 87.3 | 91.5 | 87.4 | 92.5 | 87.6 | 91.8 | 87.6 | 91.9 | 88.9 | 91.9 | 86.9 | 92.2* |
| Vitamin A | 60.7 | 68.4* | 61.9 | 68.7* | 64.9 | 64.5 | 62.1 | 68.7 | 65.0 | 63.2 | 63.2 | 66.4 |
| Vitamin C | 75.3 | 82.8* | 76.7 | 82.5 | 77.9 | 80.7 | 78.6 | 80.1 | 78.8 | 80.2 | 77.0 | 81.4 |
| Calcium | 44.4 | 50.6 | 44.0 | 52.4* | 50.1 | 44.8 | 48.0 | 47.0 | 47.5 | 47.1 | 45.4 | 49.9 |
| Iron | 65.4 | 72.6* | 66.4 | 72.9 | 69.3 | 69.1 | 68.5 | 69.9 | 68.5 | 71.9 | 66.6 | 71.9 |
| Zinc | 44.1 | 53.4* | 44.8 | 54.5* | 48.1 | 49.9 | 46.0 | 53.0* | 48.0 | 52.7 | 46.0 | 52.0* |
| All participants | (48.2) | (51.8) | (58.9) | (41.1) | (54.0) | (46.0) | (59.0) | (41.0) | (81.7) | (18.3) | (52.3) | (47.7) |

[a]Percentage of households that reported engaging or not engaging in the specified food shopping practice "pretty much every time" who met 100% RDA.

*Cochran-Mantel-Haenszel chi-square $p < .05$; **Cochran-Mantel-Haenszel chi-square $p < .01$.

Source: RTI analysis of the 1996 National Food Stamp Program Survey.

The analyses compared the likelihood of meeting 100% of the RDA for the nutrients among food stamp households in which the primary shopper reported engaging in three or more careful shopping practices "pretty much every time" to households in which the primary shopper reported engaging in less than three careful shopping practices. Approximately half of the households (52%) were below this level, and half (48%) were above this level. The results indicate that engaging in these careful shopping practices was associated with the availability of 100% of the RDA in the household. Food stamp households in which the primary food shopper engaged in three or more careful shopping practices "pretty much every time" were significantly more likely than households where the food shopper engaged in careful shopping practices less frequently to have met each of the eight different RDAs (Table 4). These findings were strongest for vitamin $B_6$ (72% vs. 59%, $p \leq .001$).

A multiple logistic regression model that adjusted for household size and household income found that households that "pretty much every time" engaged in three or more careful shopping practices were 1.82 times more likely to have met the RDAs for vitamin $B_6$ (see Table 4) than households that used careful shopping practices less often. Significant ($p \leq .05$) odds ratios on these models ranged from a low of 1.38 times for calcium and vitamin A to a high of 1.82 times for vitamin $B_6$. These analyses indicate that engagement in careful shopping practices was associated with nutrient availability among these food stamp households.

**Findings from the Food Behavior Checklist in the EFNEP ERS.** The proportion of EFNEP participants at the baseline interview who indicated that they almost always engaged in careful shopping-related behaviors ranged from 8% for using nutrition labels to 41% for comparison shopping (Table 5). One-quarter of participants reported that they almost always shopped with a grocery list (25%). A minority of participants almost always thought about health food choices (18%) and planned meals ahead (12%). Only 25% of the participants reported that they never ran out of food by the end of the month.

Although Pearson correlations among all of these items were significant (Table 6), the correlations among the food shopping–related items (planning meals ahead, comparing prices, shopping with a grocery list, and reading food labels) were appreciably higher than the correlations with the item "running out of food before the end of the month." This suggests that running out of food by the end of the month may reflect an aspect of food resource management that is distinct from shopping practices.

Women who reported that they almost always "think about healthy food choices" were significantly more likely than other women to meet 100% of the RDA for vitamin C

**Table 4.** Relationship between degree of engagement in careful food shopping practices and achievement of 100% RDA availability of selected nutrients in the households of Food Stamp Program participants (n = 947).[a]

| *RDA* | *0–2 Shopping Practices* | *3–6 Shopping Practices* | *Cochran-Mantel-Haenszel Chi-square (p Value)* | | *Odds Ratio (95% CI) (Covariates: Income, Household Size)* | |
|---|---|---|---|---|---|---|
| Vitamin $B_6$ | 58.9 | 72.5 | 15.6 | (<.001) | 1.82[a] | (1.34–2.47)[b] |
| Folate | 75.4 | 83.6 | 8.9 | (.005) | 1.62 | (1.16–2.27) |
| Protein | 86.6 | 92.7 | 4.0 | (.052) | 1.94 | (0.97–3.85)* |
| Vitamin A | 61.0 | 68.6 | 5.6 | (.023) | 1.38 | (1.03–1.86) |
| Vitamin C | 76.1 | 82.9 | 7.2 | (.011) | 1.45 | (1.05–2.00) |
| Calcium | 44.6 | 50.8 | 4.5 | (.042) | 1.38 | (1.05–1.81) |
| Iron | 65.1 | 73.4 | 9.4 | (.004) | 1.51 | (1.15–1.99) |
| Zinc | 44.3 | 53.8 | 8.2 | (.007) | 1.52 | (1.16–2.00) |
| All participants | (51.6) | (48.4) | | | | |

[a]This table compares the nutrient availability in food stamp households where the primary shopper did not or did "pretty much every time" engage in three or more careful food shopping practices. Data came from a stratified random national sample of 947 food stamp participants who completed 7-day dietary records in the 1996 National Food Stamp Program Survey.

[b]Odds ratio adjusted for household size and 75% poverty status (n = 912).

[c]95% confidence interval. In the case of vitamin $B_6$, the odds ratio is 1.82 and the 95% confidence interval for the estimate of the odds ratio extends from a lower bound of 1.34 to an upper bound of 2.47. Any odds ratio for which the lower bound of the confidence interval extends below 1.0 is not statistically significant.

*Not statistically significant.

Source: RTI analysis of the 1996 National Food Stamp Program Survey.

RDA = Recommended Dietary Allowance.

**Table 5.** Percentage of EFNEP participants who reported engaging in various food shopping behaviors at baseline.[a]

| *Food Shopping Behavior* | *N* | *Do Not Do* | *Seldom* | *Sometimes* | *Most of the Time* | *Almost Always* |
|---|---|---|---|---|---|---|
| Think about healthy food choices | 5144 | 8.4 | 11.5 | 31.0 | 31.2 | 17.8 |
| Plan meals ahead | 5157 | 15.4 | 15.0 | 33.0 | 24.9 | 11.6 |
| Shop with a grocery list | 5144 | 21.0 | 12.6 | 22.7 | 19.0 | 24.7 |
| Compare prices before buying food | 5159 | 7.5 | 7.0 | 17.8 | 26.9 | 40.9 |
| Use the Nutrition Facts panel on the food label to make food choices | 5120 | 31.6 | 22.9 | 26.4 | 11.2 | 7.9 |
| Run out of food before the end of the month | 5139 | 24.9 | 23.2 | 28.9 | 13.0 | 10.1 |

[a]This table presents data on the food shopping behavior of nonpregnant, nonlactating adolescents and women aged 12–50 participating in the Expanded Food and Nutrition Education Program (EFNEP) in selected counties from four states.

(54% vs. 48%, $p \leq .01$), vitamin A ($p \leq .01$), vitamin $B_6$ ($p \leq .01$), and iron ($p \leq .05$) (Table 7). Women who reported that they almost always planned meals ahead were significantly more likely than other women to meet the RDA for vitamin A (35% vs. 31%, $p \leq .01$).

In addition, women who said that they almost always used Nutrition Facts on food labels to make food choices had significantly ($p \leq .01$) lower consumption of fat (grams) than did those who did not use or only seldomly used Nutrition Facts (Table 8). In contrast, using Nutrition Facts was not significantly ($p \leq .05$) associated with fiber consumption.

## DISCUSSION

The results from this study support findings from Murphy et al.[11] Food shopping practices can influence nutrient intake in low-income households and are therefore key topics to be covered in nutrition education.

This study has several limitations. It did not establish the reliability or validity of measures of food shopping practices. Reliability can be assessed by comparing how consistently people report their food shopping practices if they are asked the same questions more than once.[19] Assessment of validity, the extent to which a test measures what it claims to measure, requires independent verification of actual behavior (e.g., food shopping practices).[19] Such validation has not been conducted with these self-reported food shopping behavior checklists. However, these analyses offer support for the validity of the food shopping measures by demonstrating that a relationship does exist between self-report measures of food shopping practices and dietary quality.

There are also limitations in the dependent measures of these studies. The 7-day food record has been used in national

**Table 6.** Pearson correlation coefficient matrix for food shopping behaviors among EFNEP participants.[a]

| *Food Shopping Behavior* | *1 Think about Healthy Choices* | *2 Plan* | *3 Shop with Grocery List* | *4 Compare* | *5 Use Labels* | *6 Run Out of Food* |
|---|---|---|---|---|---|---|
| Think about healthy food choices | 1.000 | | | | | |
| Plan meals ahead | .318*** | 1.000 | | | | |
| Shop with a grocery list | .271*** | .302** | 1.000 | | | |
| Compare prices before buying food | .297*** | .318*** | .306*** | 1.000 | | |
| Use Nutrition Facts on the food label to make choices | .359*** | .215*** | .222*** | .236*** | 1.000 | |
| Run out of food before the end of the month | .049* | .035*** | .037* | –.042* | .050** | 1.000 |

[a]n = 5139 nonpregnant, nonlactating adolescents and women aged 12–50 participating in the Expanded Food and Nutrition Education Program (EFNEP) in selected counties from four states at baseline.

*$p \leq .05$; **$p \leq .01$; ***$p \leq .001$.

**Table 7.** Percentage of EFNEP participants who engaged in specific food shopping behaviors related to 100% RDA consumption of specific nutrients.[a]

| | *Think about Healthy Food Choices (n = 5144)* | | *Plan Meals Ahead (n = 5157)* | | *Shop with a Grocery List (n = 5144)* | | *Compare Prices Before Buying Food (n = 5159)* | | *Use Nutrition Facts on the Food Label to Make Food Choices (n = 5120)* | | *Run Out of Food Before the End of the Month (n = 5139)* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Nutrient* | Less Often | Almost Always | Less Often | Almost Always | Less Often | Almost Always | Less Often | Almost Always | Less Often | Almost Always | Never | More Often |
| Vitamin $B_6$ | 18.5 | 22.1** | 19.3 | 18.4 | 19.1 | 19.4 | 18.7 | 19.8 | 19.0 | 20.9 | 21.2 | 18.4* |
| Protein | 65.7 | 69.1* | 65.9 | 68.3 | 65.9 | 66.8 | 66.3 | 66.0 | 66.4 | 63.0 | 68.0 | 65.5 |
| Vitamin A | 30.6 | 35.1** | 30.9 | 35.1* | 30.9 | 32.9 | 31.3 | 31.4 | 31.5 | 31.3 | 33.3 | 30.7 |
| Vitamin C | 47.6 | 53.8** | 48.3 | 51.7 | 48.7 | 48.4 | 48.8 | 48.5 | 48.4 | 53.0 | 52.5 | 47.3** |
| Calcium | 30.5 | 32.6 | 30.8 | 30.7 | 30.3 | 32.2 | 30.8 | 30.7 | 30.9 | 30.5 | 31.6 | 30.4 |
| Iron | 15.2 | 18.0* | 15.5 | 17.2 | 15.5 | 16.0 | 15.7 | 15.6 | 15.4 | 17.0 | 16.4 | 15.3 |
| All participants | (82.2) | (17.8) | (88.6) | (11.4) | (75.9) | (24.1) | (60.0) | (40.0) | (92.3) | (7.7) | (24.9) | (75.1) |

[a]This table shows the percentage of women who "almost always" engaged in a specified food shopping behavior and met 100% Recommended Dietary Allowance (RDA). It also shows the percentage of women who met the 100% RDA if they engaged in this food shopping practice "less often" (i.e., one of the four response categories other than "almost always").

*Cochran-Mantel-Haenszel chi-square $p < .05$; **Cochran-Mantel-Haenszel chi-square $p < .01$.

Source: RTI analysis of the 1999 baseline Expanded Food and Nutrition Education Program (EFNEP) data selected from counties in four states.

studies to calculate food availability,[20] and the estimates of household food availability in the NFSPS are very similar to estimates for low-income households on the CSFII.[10] Nonetheless, because it includes cooking and plate waste and relies on statistical adjustments for differences in household size and composition, a measure of nutrient availability at the household level is not necessarily as clear an indicator of diet as are individual intake measures.

Conversely, although the EFNEP study provides data on individual intake, a single day of 24-hour recall does not usually provide the same degree of reliability as multiple days of 24-hour recall data,[19] although data on a single 24-hour recall have been found to be associated ($p \leq .05$) with biochemical measures of nutrients in an EFNEP population.[11]

The biggest limitation is that this analysis does not prove that careful food shopping practices result in improved diet.

**Table 8.** Relationship between frequency of using Nutrition Facts panel of the food label and mean consumption of fat and fiber at baseline among EFNEP participants.[a]

| | *Frequency of Reading Food Labels* | | | *Most of the Time* | *Almost Always* |
|---|---|---|---|---|---|
| *Outcome* | *Do Not Do* | *Seldom* | *Sometimes* | | |
| Fat (g) | | | | | |
| N | 1616 | 1173 | 1354 | 571 | 406 |
| Mean | 73.3[b] | 72.8[b] | 71.5[c] | 67.6 | 64.8[d] |
| SD | 57.2 | 46.8 | 60.3 | 49.7 | 41.9 |
| Fiber (g) | | | | | |
| N | 1616 | 1173 | 1354 | 571 | 406 |
| Mean | 12.3 | 12.6 | 12.5 | 12.2 | 12.8 |
| SD | 10.2 | 11.1 | 10.3 | 10.3 | 10.5 |

[a]This table shows the mean grams of fat and fiber consumed by respondents who reported different frequencies of using Nutrition Facts on the food label to make food choices. Respondents were nonpregnant, nonlactating adolescents and women 12–50 years old participating in the Expanded Food and Nutrition Education Program (EFNEP) in selected counties of four states at baseline.

[b]b vs. d: $p < .01$ using a t-test (two-tailed); [c]c vs. d: $p < .05$ using a t-test (two-tailed).

Correlation does not establish causality, and it is possible that women in households with diets that met RDAs share other, unmeasured, characteristics that might have resulted in improved shopping. Although the analyses in this study controlled for household size, household income, and household composition, this analysis could not control for all potential confounding factors. Nonetheless, the fact of a significant association—in two different studies—suggests that the relationship between food shopping practices is important to investigate. More carefully controlled intervention studies are needed to establish the direction of relationships.

The two sets of analyses complement each other. The NFSPS provides household-level, rather than individual-level, nutritional data, but these data were based on a week's food use in a nationally representative sample. The EFNEP study relies on a single 24-hour recall, but data describe the intakes of individuals rather than households. Both studies relied on cross-sectional data, so it is possible that other factors may have influenced study findings. Nonetheless, the findings suggest that food shopping practices are associated with nutrient availability and are therefore important to assess.

Because these data were collected while the nutrient standards were the RDAs,[21] analyses used those standards for comparisons. However, the dietary reference intakes (DRIs) gradually have been replacing the RDAs for most nutrients.[22–25] With regard to the nutrients used for analyses with food shopping behaviors in this article, recommendations for folate,[23] vitamin C,[24] and iron[25] have increased, whereas recommendations for vitamin $B_6$,[23] vitamin A,[25] and zinc[25] have decreased. The RDA for calcium was changed from 1200 mg/day for 19- to 24-year-old females and 800 mg/day for 25- to 50-year-old females to an adequate intake (AI) recommendation of 1000 mg/day for females aged 19 to 50.[22] Future studies need to examine food shopping behaviors with relation to these newer standards. Still, these differences in nutrient standards are unlikely to affect the major finding of this study—namely, the relationship between shopping practices and either nutrient availability or nutrient intake.

The findings appear to be fairly robust. This article focuses on the 100% RDA level because that result is easier to interpret. However, analysis found similar relationships between food shopping practices and availability (in NFSPS) or consumption (in the EFNEP) of 75% of the RDA. The analysis of the number of careful food shopping practices found stronger bivariate relationships when we chose three or more careful food shopping practices as a cutpoint rather than an alternative (e.g., four or more). But this choice did not appear to be associated with any unusual pattern in the data; rather, we selected three or more because it was close to the median of the sample (52% were lower than this value and 48% were higher), and equal sample sizes typically result in somewhat greater statistical power than the more uneven sample sizes that would have resulted from an alternative cutpoint. Nonetheless, questions about the number and combination of food shopping practices associated with dietary quality in low-income families deserve further study.

Both studies analyzed in this article indicate that careful food shopping practices (Table 9) were reported by a substantial proportion of low-income households. For instance, 41% of FSP participants and 41% of EFNEP participants, at baseline, engaged in comparison shopping "pretty much every time" (NFSPS) or "almost always" (EFNEP). About half of FSP participants in the NFSPS reported that they "pretty much every time" looked for specials (51%) or used a shopping list (50%), stocked up on bargains (42%), or used coupons (41%). This suggests that many careful food shopping practices can be employed by low-income populations. On the other hand, less than one-fifth of FSP participants shopped in different supermarkets for specials (18%), so this may not be practical for many low-income families.

Clearly, many of the food shopping skills taught in nutrition education programs (e.g., comparison shopping) make intuitive sense. The two studies analyzed in this article (one with participants in the EFNEP and another with a national sample of FSP participants) both demonstrated statistically significant ($p < .05$) relationships between careful food shopping practices and nutrient availability (see Table 9).

One possibility is that these relationships are associated less with any particular shopping practice than with a combination of food shopping practices. For instance, Campbell and Desjardins[2] suggested that households use multiple approaches to take maximum advantage of their resources.[5] This is consistent with the finding in this study that engagement in three or more careful shopping practices was significantly associated with nutrient availability. Interestingly, analysis of the EFNEP ERS data found that the strongest association of any single food shopping practice with diet quality was "thinking about healthy food choices." Hence, the effects of a more general awareness of nutrition that might influence a variety of food shopping practices may be useful to explore further.

## IMPLICATIONS FOR RESEARCH AND PRACTICE

The overall conclusion of this study is that the food shopping practices of low-income families are associated with diet quality; as such, this is an area that deserves increased attention in nutrition education and evaluation efforts. There is a need for research to assess the reliability of these measures and the validity with which the self-report measures from low-income respondents reflect actual food shopping practices. This study also points to the value of additional research about the types of food shopping practices that contribute to the diet of low-income families. Although the results from this study suggest that shopping practices can play a role in improving diet, more study is needed to learn what types of skills are most useful to different people given their particular circumstances.

**Table 9.** Frequency (%) of using recommended food shopping practices and its relationship to dietary quality among Food Stamp Program and EFNEP participants.

| *Food Shopping Practice* | *FSP "Pretty Much Every Time" (n = 2142)* | *EFNEP "Almost Always" (n = 5159)* | *Relationship to Dietary Quality* |
|---|---|---|---|
| Look for grocery specials | 51.4 | NM | Logistic regression model with FSP participants (controlling for age, income, and household size) found that "pretty much every time" engaging in 3 or more careful shopping practices was significantly associated with 100% RDA nutrient availability for vitamins $B_6$, A, and C; folates; calcium; iron; and zinc |
| Use a shopping list (shop with a grocery list) | 50.1 | 24.7 | |
| Stock up on bargains | 42.3 | NM | |
| Comparison shop (compare prices before buying) | 41.1 | 40.9 | |
| Use coupons | 40.5 | NM | |
| Shop in different stores for specials | 17.6 | NM | |
| Use Nutrition Facts panel on the food label to make food choices | NM | 7.9 | Related to lower fat consumption as determined by 24-hour recall among EFNEP participants |
| Think about healthy food choices | NM | 17.8 | Related to RDAs (vitamins A, C, and $B_6$; protein; and iron) in 24-hour recall in EFNEP participants |
| Plan meals ahead | NM | 11.6 | Related to RDA for vitamin A in 24-hour recall in EFNEP participants |
| Run out of food before the end of month | NM | 10.1 | Related to RDAs for vitamins C and $B_6$ in 24-hour recall in EFNEP participants |

FSP = Food Stamp Program; EFNEP = Expanded Food and Nutrition Education Program; NM = not measured; RDA = Recommended Dietary Allowance.

This study did not assess the extent to which nutrition education affects food shopping practices. This remains an important area for investigation, and there will be considerable value in research and sharing of ideas about strategies that improve food shopping practices with low-income families.

In conclusion, this study does not prove that food shopping practices result in improved nutrition among low-income families. Nonetheless, the association between food shopping practices and increased nutrient availability and/or intake that achieves 100% of the RDA levels suggests that this will be an important area for research and practice.

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# Evaluation of Food Safety Education for Consumers

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**ABSTRACT** Traditionally, nutrition educators have used a fairly global approach to teach food safety by teaching a broad range of safe food handling behaviors in the expectation that this will lead to the avoidance of foodborne illness. This approach can be confusing and lead to evaluation data that are difficult to interpret. This article suggests that food safety education and evaluation in the future be organized around five behavioral constructs: practice personal hygiene, cook foods adequately, avoid cross-contamination, keep foods at safe temperatures, and avoid food from unsafe sources. These five constructs are derived from data on actual outbreaks and estimated incidences of foodborne illness. Research is needed to establish reliable and valid evaluation measures for these five behavioral constructs. Evaluation instruments can be tailored to fit specific education programs. If evaluation instruments focus on these five behavior areas, the result will be meaningful evaluation data that can be more easily summarized across food safety education programs for consumers.

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## INTRODUCTION

The actual number of foodborne illnesses occurring in the United States is unknown. The Centers for Disease Control and Prevention (CDC) has estimated that foodborne contaminants cause approximately 76 million illnesses, 325,000 hospitalizations, and 5000 deaths in the United States each year.[1] Healthy People 2010[2] has set goals to reduce the number of outbreaks and cases of foodborne illness caused by key foodborne pathogens by 50% from 1997 to 2010. Most outbreaks and cases of foodborne illness result from the transfer of microbial contaminants from food to humans. Fortunately, the behaviors and food handling practices that promote foodborne illness have been identified[3] and can be associated with particular organisms.[4]

Most cases of foodborne illness are preventable if food protection principles are followed throughout the food chain, from production to consumption. Since it is currently impossible for food producers and processors to ensure a pathogen-free food supply, the home food preparer is an essential link in the chain to prevent foodborne illnesses. Thus, home food preparers need to know how to minimize the presence of pathogens or their toxins in food. This is no small task since there are any number of places during food preparation, handling, and storage where food can be mishandled,[3,5] and studies show that consumers have inadequate knowledge about measures needed to prevent foodborne illnesses in the home.[5–7]

According to Bryan,[8] only a few types of food handling errors are responsible for the majority of foodborne illness cases. Therefore, he recommends that educators concentrate their food safety efforts on high-risk operations rather than emphasizing all food safety operations equally.[8] It also follows that evaluation instruments used for food safety education should focus on those practices most important in preventing foodborne illness.

## FIVE KEY BEHAVIORAL CONSTRUCTS FOR FOOD SAFETY EDUCATION

This article suggests that both education and evaluation of that education be focused around five behavioral constructs. These constructs were selected after a thorough literature review addressing estimates of the incidence of foodborne illness from each common pathogen, common food sources and food handling errors associated with each pathogen, and consumer behaviors regarding food handling in the home.[9] The five behavioral constructs are (1) practice personal hygiene, (2) cook food adequately, (3) avoid cross-contamination, (4) keep foods at safe temperatures, and (5) avoid food from unsafe sources. The organisms that predominantly cause foodborne illnesses and the factors contributing to actual outbreaks are directly related to these five constructs.

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Between 1973 and 1987, homes accounted for 21% of the reported outbreaks when the preparation site of implicated food could be identified.[10] Factors contributing to these outbreaks are listed in Table 1. Contaminated raw foods, inadequate cooking, and consumption of food from an unsafe source were the factors most commonly associated with reported outbreaks of foodborne disease in homes. Many of these factors can be at least partly controlled by adequate cooking. Improper cooling and hot holding were factors in about 25% of the outbreaks. The items specifically related to poor personal hygiene and cross-contamination accounted for about 10% and 3% of reported outbreaks, respectively. Although cross-contamination is not high on the list of contributing factors associated with home-prepared foods, there are many opportunities for cross-contamination in home settings.[8] Bryan suggested that educational efforts for home food preparers should focus on avoiding cross-contamination and on proper heating and cooling procedures.[8]

Because only a small (but unknown) proportion of foodborne illnesses is reported, caution is required when examining data about reported outbreaks of foodborne illnesses. This caution is particularly important when looking at data related to illnesses caused by home food preparation because sporadic cases and outbreaks involving small numbers of people are rarely reported to the CDC. Thus, foodborne illnesses resulting from home food preparation are likely to be much more common than indicated by reported data.[5]

Observational studies of consumer food handling behavior[11–14] support this assumption. For example, using audit forms commonly used in restaurant settings, Daniels[11] found that 96% of 106 households audited had at least one critical violation (one that could potentially lead to a foodborne illness). In a follow-up study using less strict standards,[12] critical violations were still seen in 60% of the homes studied. Observational studies in the United Kingdom[13] and Australia[14] have also reported a relatively high rate of unsafe food handling practices. In these latter two studies, examples of poor personal hygiene and cross-contamination were seen in 45 to 60% of the homes studied. Improper cold storage or hot holding and inadequate cooking were also seen but at somewhat lower occurrence rates (10–35%). Neither study addressed consumption of foods from unsafe sources.

An example of an existing food safety education program that focuses on a set of behavioral constructs is the Fight BAC!™ campaign. This program organizes its educational concepts around four categories: clean (wash hands and surfaces often), separate (do not cross-contaminate), cook (cook to proper temperatures), and chill (refrigerate promptly).[15] There are two differences between the Fight BAC! organizational structure and the one proposed here. First, the approach presented here adds the category "avoid food from unsafe sources." Second, surface and equipment contamination are included under cross-contamination instead of under cleaning as they are in the Fight BAC! materials.

## REVIEW OF FOOD SAFETY CURRICULA AND EVALUATION TOOLS

To determine which concepts were being used in current food safety curricula, the authors sent an electronic mail request for curricula and corresponding evaluation instruments to food and nutrition professionals through the fnspec_mg listserve (fnspec_mg@ecn.purdue.edu). This listserve, which addresses topics related to conveying knowledge to the general public about food safety and nutrition, has many subscribers from the Cooperative State Research, Education and Extension Service of the U.S. Department of Agriculture.

Twelve curricula were received and evaluated in response to the request. It was not the intent of the authors to locate and review all food safety curricula but to evaluate a set of

**Table 1.** Factors contributing to outbreaks of foodborne disease in homes, 1973–1982.

| *Rank* | *Contributing Factor* | *%** | *Behavior Construct* |
|---|---|---|---|
| 1 | Contaminated raw food/ingredient | 42.0 | Multiple |
| 2 | Inadequate cooking/canning/heat processing | 31.3 | Cook foods adequately |
| 3 | Obtained food from unsafe source | 28.7 | Avoid food from unsafe sources |
| 4 | Improper cooling | 22.3 | Keep foods at safe temperatures |
| 5 | 12 or more hours between preparing and eating | 12.8 | Keep foods at safe temperatures |
| 6 | Colonized person handling food | 9.9 | Practice personal hygiene |
| 7 | Toxic substance mistaken for food | 7.0 | Avoid food from unsafe sources |
| 8 | Improper fermentation | 4.6 | Avoid food from unsafe sources |
| 9 | Inadequate reheating | 3.5 | Cook foods adequately |
| 10 | Toxic containers | 3.5 | Avoid food from unsafe sources |
| 11 | Improper hot holding | 3.2 | Keep foods at safe temperatures |
| 12 | Cross-contamination | 3.2 | Avoid cross-contamination |

*Percentage exceeds 100 because multiple factors contribute to a single outbreak. Data regarding contributing factors are from Knabel.[5]

typical curricula. The materials received were likely state of the art in food safety education since people who presumably thought they were good enough to share with others voluntarily sent them in. Materials were evaluated for target audience, topics covered in the curricula and on the evaluation instruments, type and format of the evaluation instruments, and assessments of instrument reliability and/or validity. This analysis is shown in Table 2.

## FINDINGS

**Target audience.** Seven of the curricula evaluated were developed for an adult audience, four were targeted to youth, and one was developed for preschoolers and their parents. One set of materials consisted of general instruments designed for use with adults. Two sets of curricula were available in Spanish, and six were considered suitable for low-literacy audiences.

**Topics covered.** The authors analyzed the subject matter of the curricula and the accompanying evaluation instruments to determine the extent that their contents were related to the five behavioral constructs identified previously. None of the curricula or evaluation instruments reviewed was organized by behavioral construct, and none included all five behavioral constructs in their materials. However, eight of the curricula both covered and evaluated for four of the constructs: practice personal hygiene, cook foods adequately, avoid cross-contamination, and keep foods at safe temperatures. The other curricula covered and/or tested for fewer constructs. Overall, most of the curricula reviewed included activities and evaluation questions covering personal hygiene and cold storage/hot holding. Information and evaluation

**Table 2.** Food safety educational resources and evaluation tools.

| *Program Title* | *Audience* | *Topics Covered*[a] | *Evaluation Format* | *Reliability* | *Validity Testing* | *Comments* |
|---|---|---|---|---|---|---|
| Detective Mike Robe's Fantastic Journey, Department of Food Science and Nutrition, University of Rhode Island Cooperative Extension Service, Kingston, RI | Preschool | Curriculum: 1, 2, 3, 4 | 8 program evaluation questions | No testing | No testing | |
| Chance and Choices with Food, Department of Food Science and Nutrition, University of Minnesota Extension Service, St. Paul, MN | Youth | Curriculum: 1, 2, 3, 4<br>Evaluation: 1, 2, 4 | Knowledge: 9–10 questions per test | No testing | Pre-/post-tests reviewed for difficulty; difficult questions discarded | 4 pre-/post-tests |
| Operation Risk, Michigan State University Cooperative Extension, East Lansing, MI | Youth | Curriculum: 1, 2, 4, 6<br>Evaluation: 1, 4 | Knowledge: 12 questions, multiple choice<br>Behavior: 8 questions, multiple choice | Not available | Face and content validity review | Secondary school classroom; teacher/leader guide with media materials |
| Bacterial Contamination of Food: Fast Plants, Fast Food—How Safe? Department of Food Science, Penn State University Cooperative Extension, University Park, PA | Youth | Curriculum: 1, 2, 3, 4, 6<br>Evaluation: 1, 2, 3, 4, 6 | Knowledge: 32 questions, multiple choice<br>Attitude: 42 questions, Likert scale | Knowledge: Cronbach's alpha = .72<br>Attitude: Cronbach's alpha = .76 | No testing | Multidisciplinary approach; essay question for final examination |

**Table 2.** *Continued*

| *Program Title* | *Audience* | *Topics Covered* | *Evaluation Format* | *Reliability* | *Validity Testing* | *Comments* |
|---|---|---|---|---|---|---|
| Meeting the Food Safety Needs of Bilingual and Low Literacy Youth, Purdue University Cooperative Extension, West Lafayette, IN | Youth<br>Low literacy | Curriculum: 1, 3, 4, 6<br>Evaluation: 1, 3, 4 | Knowledge: 10 questions, multiple choice | Item analysis | Larger instrument pretested; very difficult or easy questions discarded | English/Spanish versions; uses microbiologic techniques |
| Safe Food Handling for Occasional Quantity Cooks, Ohio State University Extension Service, Columbus, OH | Adults | Curriculum: 1, 2, 3, 4, 6<br>Evaluation: 1, 2, 3, 4 | Knowledge: 25 questions, multiple choice<br>Behavior: 5 behavior checklists | Knowledge: Cronbach's alpha = .93 | Reviewed by 5 university faculty members | HACCP-based lessons for temporary food service |
| Keep Food Safe, Ohio State University Extension Service, Columbus, OH | Adults<br>Low literacy | Curriculum: 1, 2, 3, 4, 6<br>Evaluation: 1, 2, 3, 4 | Knowledge: 10 questions<br>Behavior: 39 questions | No testing | No testing | HACCP-based lessons; English/Spanish versions |
| Safe Food at Home, University of Massachusetts Cooperative Extension System, Amherst, MA | Adults<br>Low literacy | Curriculum: 1, 2, 3, 4, 6<br>Evaluation: 1, 2, 3, 4 | Knowledge: 5 questions, safe/unsafe<br>Behavior: 5 questions, Likert scale | Cronbach's alpha = .67<br>Cronbach's alpha = .47 | No testing | Train-the-trainer course for community-based homes for developmentally disabled; pre/post knowledge test |
| Food SAFE: Safety Awareness in the Food Environment, University of Vermont Extension System, St. Johnsbury, VT | Adults | Curriculum: 1, 2, 3, 4, 6<br>Evaluation: 1, 2, 4 | Knowledge: 11 questions, multiple choice<br>Critical thinking: 1 question | No testing | No testing | HACCP-based program for food managers<br>Pre/post knowledge test |
| Serve It Safely to Seniors: Safe Food Handling in Elderly Feeding Programs, University of Connecticut Cooperative Extension Service, Hamden, CT | Adults | Curriculum: 1, 2, 3, 4<br>Evaluation: 1, 2, 3, 4 | Knowledge: 10 questions, true/false<br>Awareness: 1 question<br>Behavior: 1 question | No testing | No testing | |
| SAFE (Safety and Food Excellence): Safe Food Handling Education Program for Food Service Workers, Colorado State University Cooperative Extension, Fort Collins, CO | Adults | Curriculum: 1, 2, 3, 4, 6<br>Evaluation: 1, 2, 3, 4, 5 | Knowledge: 14 questions, safe/unsafe<br>Behavior: goal/follow-up, 1 question; follow-up instrument, 19 questions | 66–69% agreement among similar items | Face and content validity review | Train-the-trainer program for food service settings; pre/post knowledge test<br>Workshop evaluation tool includes self-efficacy questions |

**Table 2.** *Continued*

| *Program Title* | *Audience* | *Topics Covered* | *Evaluation Format* | *Reliability* | *Validity Testing* | *Comments* |
|---|---|---|---|---|---|---|
| Food, Nutrition, and Health: Program Evaluation Instruments, University of Tennessee Agricultural Extension Service, Knoxville, TN | Adults Low literacy | Evaluation instruments test for: 1, 2, 4, 6 | Behavior: 6 questions | No testing | No testing | Instruments that can be used to assess self-reported behaviors; there is no curriculum associated with the evaluation instruments |

[a]1 = practice personal hygiene; 2 = cook foods adequately; 3 = avoid cross-contamination; 4 = keep foods at safe temperatures; 5 = avoid food from unsafe sources; 6 = awareness/motivation.
HACCP = Hazard Analysis Critical Control Point.

measures on adequate cooking and avoiding cross-contamination were more limited; avoiding food from unsafe sources was rarely mentioned in these curricula.

Curricula were also assessed with respect to increasing the awareness of food safety issues and motivating participants to follow safe food handling behaviors. Most of the curricula reviewed included some aspects of these elements in the curricula but not in the evaluation instruments.

**Evaluation format.** The authors examined the evaluation instruments to assess whether the questions asked were related to knowledge, self-reported behavior changes, and/or self-efficacy (the belief in one's ability to act). Seven of the instruments evaluated included both knowledge and self-reported behavior questions. Four contained only knowledge-based questions, and one contained only behavior-based questions. Self-efficacy measurement tools for food safety behaviors were limited; only one instrument included a measure of perceived self-efficacy.

**Reliability/validity.** The developers of each curriculum were contacted to determine if reliability and/or validity assessments had been conducted on the evaluation instruments. Only half of the evaluation instruments reviewed had been tested for reliability and/or validity, and then to varying extents. Clearly, more rigor is needed in the development and pretesting of evaluation instruments if educators are to have confidence in the outcomes reported.

**Behavioral mediators of food safety.** Knowledge alone does not lead to behavior change. To be effective, food safety education must both increase consumers' awareness about risks and motivate them to change their food handling and consumption behaviors.[6] Behavioral theories can be useful in both understanding and promoting desired changes in consumer behavior. According to Bandura's Social Cognitive Theory,[16] a desired outcome, such as not using the same cutting board to cut up chicken and prepare salad, occurs due to a combination of efficacy and outcome expectations. An outcome expectation is a person's estimate that a given behavior will lead to certain outcomes; an efficacy expectation is the belief that one can successfully execute the behavior required to produce the outcomes.[16] Self-efficacy has been shown to be a powerful predictor of health behavior.[17] Self-efficacy was a common conceptual component in the educational resources reviewed; however, only one curriculum included an evaluation tool that measured perceived self-efficacy.

The Health Belief Model[18] has been used as a framework for determining mediators of food safety behavior. Schafer et al.[19] used concepts related to the Health Belief Model to assess action taken by consumers regarding food safety. Schafer and colleagues approached food safety behavior as a function of perceived threat (readiness), outcome expectations, and efficacy expectations. In their study, consumers were more likely to engage in food safety behaviors if they perceived unsafe food as a personal threat, saw benefits to following specified food safety actions, and had a high self-efficacy.

The transtheoretical model developed by Prochaska et al.[20] is another model gaining acceptance as a theoretical framework for food safety and nutrition education evaluation. The model proposes that individuals move through six stages in the process of behavior change. The stages are precontemplation, contemplation, preparation, action, maintenance, and termination. Many of the curricula reviewed had activities and content appropriate for people in the preparation and action stages. Some of the educational resources reviewed could be matched to the precontemplation and contemplation stages where awareness and knowledge activities are more effective teaching strategies than are behavioral change activities. An example is a food safety game developed for the Indiana Food Stamp Nutrition Education Program as part of the package *Food Safety: Avoiding Food-Borne Illness Through Safe Food Handling*). As more food safety educators implement educational programs based on

the stages of change theoretical framework, activities that are clearly stage matched will be needed.

## DISCUSSION

No studies were found that included evaluation tools organized to measure specific behavioral constructs. Therefore, it is not known which specific behaviors, or sets of behaviors, taught in educational programs cluster into measures of safe food handling knowledge or behaviors. Research tools are available,[6,7,21] but they have not been used in educational settings.

Measures of the five behavioral constructs (practice personal hygiene, cook foods adequately, avoid cross-contamination, keep foods at safe temperatures, and avoid food from unsafe sources) and measures to evaluate knowledge and attitudes need to be developed and validated for educational programs such as the Food Stamp Nutrition Education Program. The advantage of using an approach based on the five behavioral constructs is that teaching can be focused on specific educational needs based on knowledge of the audience. Likewise, if outcome measures developed to determine program effectiveness are based on the five constructs, links can be made to foodborne illnesses associated with specific constructs.

Research studies usually require measures of instrument reliability and validity for publication of results. Validity (the ability to measure the phenomenon intended to be measured) and reliability (the consistency of results when applied repeatedly) are also important to establish for evaluation tools used in educational programs.[22] Validity and reliability have been assessed for a few food safety educational programs.[23–25] However, as seen in Table 2, reliability and validity checks are not commonly done in the food safety education area, or if they are, the information is not readily available as part of the educational materials. Information about the reliability and validity of evaluation tools is important to establish; if instruments are unreliable or not valid, the measurement of program outcomes will be inaccurate. If other educators use such tools, the errors will be magnified further. Thus, there is a critical need for instruments that have been tested for validity and reliability.

Many questions about behaviors could be included on evaluation instruments. A key issue is determining which evaluation questions are the most predictive of true behavior and are most likely to track behavior change after an educational intervention. Findings from recent observational studies[11–14] indicate that errors in consumer food handling are common, whereas those from studies of consumers' self-reported behaviors[6,26,27] indicate that they are relatively uncommon. Additional research is needed to identify the most appropriate behaviors to track and ways to validly assess these behaviors.

The number and length of interactions with participants of food and nutrition educational programs such as the Food Stamp Nutrition Education Program are usually limited. Evaluation instruments that require extended time to administer decrease the amount of time available for teaching. Complex instruments, such as those developed primarily for research, are difficult for the lay public to read, interpret, and answer accurately. Simpler instruments appropriate for use with limited-resource audiences are available in educational resources (see Table 2), but none are organized around behavioral constructs, and information about the reliability and validity of measures is limited.

An example may help to illustrate these points. The Expanded Food and Nutrition Education Program (EFNEP) Food Behavior Checklist[28] includes two items regarding food safety,* both of which fall within one of the five domains identified in this article: keep foods at safe temperatures. The EFNEP reporting system asks low-income respondents to think about the previous month and answer the questions "How often did you thaw foods at room temperature?" and "How often did you let foods sit out for more than 2 hours?" These are answered on a 5-point scale of "almost always" to "never." Although information on other food safety behavioral constructs is commonly included in EFNEP educational curricula,[29,30] behavioral changes in these areas are not assessed in core questions of the EFNEP reporting system.

The similarity in the two food safety evaluation items on the EFNEP Food Behavior Checklist does lend them one measure of reliability: internal consistency. The assumption is made that if questions are reliable indicators of a similar underlying construct—in this case, keep foods at safe temperatures—the items will be highly correlated with one another. Cronbach's coefficient alpha is often used to measure internal consistency, where .0 indicates complete absence of internal consistency and 1.0 indicates a very high degree of consistency. In a recent analysis of data on 5093 women served by EFNEP in four states (Colorado, Oklahoma, South Dakota, and Virginia), the coefficient alpha of the two food safety items at baseline was .54 (personal communication, Anliker J, Health Systems Research, and Hersey J, Research Triangle Institute, February 25, 2000). Questions and measures of reliability are also needed for the other four constructs, practice personal hygiene, cook foods adequately, avoid cross-contamination, and avoid foods from unsafe sources.

EFNEP participant responses to the two food safety behavior questions on the EFNEP Food Behavior Checklist were compared between pre- and postprogram (6–12 months later). Among the longitudinal subsample of 2360 women who completed both the entry and the exit interview within the 12-month period covered by the data file, the percentage who let foods sit out for more than 2 hours significantly decreased from 40% preprogram to 21% in the postprogram

*In addition to the two items in the core behavior checklist, the EFNEP evaluation reporting system contains an optional master question database that states can draw from for more in-depth evaluation. This database includes questions on handwashing, adequate cooking, and cross-contamination. No information has been published on the reliability or validity of these items.

assessment (6–12 months later [$\chi^2$: 209.8, df = 1; $p \leq .001$]). Likewise, the percentage of women who let foods thaw at room temperature significantly decreased from 77% preprogram to 41% postprogram ($\chi^2$: 645.9; df = 1, $p \leq .001$) (personal communication, Anliker J, Hersey J, February 25, 2000). This level of change in reported behavior regarding cold storage/hot holding suggests that education can indeed influence food safety behaviors. Nonetheless, it must be noted that the data are based on self-reported changes, which could be influenced by such factors as social desirability. Studies are under way to validate how well reported behavior corresponds with observed behavior in this program. Such validation would be an important contribution to the field.

When developing food safety evaluation instruments, the question arises, "What are the appropriate criteria for declaring that an individual has achieved a desired behavior?" In some aspects of nutrition education, the results of undesirable behavior are cumulative and not seen until much later (e.g., a high-fat diet may eventually lead to heart disease). Although foodborne illnesses may also cause long-term complications, the impact of food safety behavior on health is usually more immediate. Today's behavior can lead directly to tomorrow's foodborne illness, with results that are immediate, debilitating, and expensive. Foodborne illness is preventable and avoidable, and each day's efforts are important rather than the cumulative effect of the behavior. Thus, the ideal goal of food safety education is that the desired behaviors are performed 100% of the time. This is the concept of zero tolerance: that is, to reduce the incidence of foodborne illness to zero, no hazardous or risky behaviors can ever be practiced or tolerated.

There is a need for food safety educators to discuss the criteria for determining if a program is successful. Although zero tolerance should ideally be the goal of food safety education, it is more of an aspiration than a reality because some food handling errors will almost certainly continue to occur, even when no incidence is the goal. Program evaluations should measure outcomes in relation to ideal behavior. It is also important to measure the program's impact on participants' progress toward achieving the desired behavior. Food and nutrition educators can develop evaluation instruments around salient items as they relate to the five behavioral constructs, measuring awareness/knowledge, and self-efficacy. The format will vary according to whether knowledge, attitude, or behavior is being assessed. Knowledge questions are typically true/false or multiple choice. Attitude questions are typically Likert scaled with choices of "strongly agree," "agree," "disagree," and "strongly disagree." For behaviors, a checkoff list works well. Such an instrument can be developed with three to five points of choice, from "never practice the behavior" to "always practice the behavior." Behaviors most likely to prevent foodborne illness would be queried. The preferred response will vary depending on whether the behavior is a desirable one ("always practice the behavior") or an undesirable one ("never practice the behavior").

Program directors can decide where to set their own goal criteria for evaluation of a successful program. In assessment of behaviors, if the goal is zero tolerance or zero cases of foodborne illness, the goal would be at the most extreme end of the scale. If more than three points are used on the scale, a more reasonable goal for food safety education programs may be set at the less stringent levels of "almost never" or "almost always." Outcome measures set up in this manner assess current behavior compared with desired behavior. A second method of assessing desired outcome is movement toward desired behavior. If program participants are assessed in a paired pre/post format, change in self-reported behavior can be tracked, and progress toward achieving ideal behavior can be reported as a successful outcome of the education program.

The same instruments and scales can be used to assess outcomes relative to both ideal behavior and progress toward ideal behavior if a paired pre/post evaluation design is used. Educational impact statements can be written based on zero tolerance or near-zero tolerance and change in behavior even when comparison data are lacking or very soft. Using a scaled behavior checkoff list as the instrument, impact statements in relation to ideal behavior can be written as shown below (for each statement, fill in the second blank with a phrasal form of one of the five constructs: practicing personal hygiene, cooking foods adequately, avoiding cross-contamination, keeping foods at safe temperatures, or avoiding food from unsafe sources):

1. For behaviors that are considered hazardous or risky: To prevent foodborne illness, ___% of (X) participants reported *never or almost never* practicing risky food handling behavior associated with _____.
2. For desirable or positive behaviors: To prevent foodborne illness, ____% of (X) participants reported *always or almost always* practicing desirable food handling behaviors associated with _____.
   For assessment of change in behavior: To reduce risk for foodborne illness, ____% of (X) participants increased the number of times they reported using desirable food handling behaviors associated with _____.

## IMPLICATIONS FOR RESEARCH AND PRACTICE

A goal of Healthy People 2010 is to reduce the incidence of foodborne illness.[2] Much work is needed to ensure that educational efforts are truly targeting this goal and that changes in the health of our nation's population are occurring because people are changing their food handling behavior. The behavioral constructs suggested in this article are based on epidemiologic data; they are envisioned as a way to focus food safety education and outcome measurement. Use of these behavioral constructs for evaluation provides data that may be helpful in assessing the results of national efforts such as the Fight BAC! campaign and Healthy People 2010 goals.

Critical behaviors related to each construct need to be identified for educational and evaluation purposes, and measurement instruments appropriate for food safety education programs need to be designed and tested.

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# Review of Evaluation Tools Used to Assess the Impact of Nutrition Education on Dietary Intake and Quality, Weight Management Practices, and Physical Activity of Low-Income Audiences

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**ABSTRACT** Nutrition education programs and social marketing campaigns frequently focus on low-income audiences with the goal of improving dietary intake and quality, weight management practices, and physical activity. The impact of nutrition education can be assessed by measuring change in relation to any or all of these broad variables. Unfortunately, little information is available concerning the reliability, validity, and sensitivity to change of measures used to assess these constructs with low-income audiences of adults and adolescents. This article reviews the literature and discusses the types of available measures that have been used and evaluated for the above audiences. It describes specific measures used to assess total diet, consumption of food groups from the Food Guide Pyramid, and behaviors related to weight management and physical activity. Overall, this review suggests that there is a critical need for additional development and evaluation of dietary quality measurement tools for low-income and minority audiences.

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## INTRODUCTION

The impact of nutrition education programs on adults and adolescents has been under-researched. There is no gold standard for dietary evaluation of free-living people and little consensus concerning appropriate methods for assessing the impact of nutrition education on low-income populations. As a result, many have found it difficult to demonstrate the impact of nutrition education on the clients they serve. This article reviews dietary assessment methods that have been used with adult and adolescent low-income audiences. Measures of total diet and diet quality based on the Food Guide Pyramid (FGP) are reviewed regarding their reliability, validity, and practicality; however, testing with low-income audiences has not been done in most cases.[1] In keeping with the emphasis placed on weight management and physical activity in the 2000 Dietary Guidelines for Americans, methods for assessing these constructs are also reviewed.[2] Gaps in the literature are identified, and suggestions are offered for future research, practice, and policy making. For the purposes of this review, the FGP is used as the standard of dietary intake and quality since most nutrition education focuses on improving food consumption behavior.

## MEASURES OF DIETARY QUALITY

Methods of measuring self-reported food consumption can be classified as (1) data collection at the time of consumption or (2) data collected about foods eaten in the immediate, recent, or distant past. Each method has strengths and weaknesses, and none can be considered as criterion mea-

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sures.[3–5] All measures that rely on self-reported food consumption have limitations influenced by the interviewer's skills and the respondent's judgment, memory, cooperation, ability to estimate serving sizes, and communication skills. Staff training and support may improve the quality of data obtained. For example, interviewers need to know that providing food models,[6,7] prompting, or other assistance may improve the accuracy of responses, especially for older adults and those with limited literacy skills.

## CHARACTERISTICS OF INSTRUMENTS FOR MEASURING CHANGE IN DIETARY QUALITY

Table 1 summarizes the key characteristics of measures that have been used with low-income populations or with national or state-level surveillance studies, including most that are discussed in this article. The table provides a useful starting point in seeking more detailed information about a particular measure. The measures in this table are organized under categories that reflect the broad types of data collection instruments employed. These include 1-day and multiday FFQs, 24-hour dietary recall measures, food behavior checklists, measures of behavioral mediators of food group intake, and measures related to weight management and physical activity (PA). The table provides guidance for instrument selection, based on the following:

- *Topics.* The topics covered by data collection instruments.
- *Mode of Data Collection.* The recommended way to administer the instrument. Instruments may be administered in person or by telephone survey, in small groups of 2 to 15 individuals, or in large groups of 16 or more. Although the major constraint on the mode of administration is time (e.g., telephone interviews often result in discontinuation after 20 minutes), some instruments—such as 24-hour dietary recalls—are sufficiently complex to work better in person and in small-group settings. Instruments need to be reviewed for ease of administration, clarity of language, reading level, and cultural relevance and sensitivity.
- *Length.* This heading includes the length of an instrument estimated in terms of the number of items (including any follow-up items) or the number of minutes needed to complete a series of items. Administration time varies according to the education, cultural background, and eating habits of respondents.
- *Measurement Properties and Study Population.* Because measures can often perform differently in different populations, the entries in these columns begin with a brief description of the study population.
  - *Reliability.* Reliability may be reported as either internal consistency (i.e., Cronbach's coefficient alpha) or as test–retest reliability (typically expressed as a correlation coefficient).
  - *Validity.* Two types of validity information are included: (1) correlation of results from the instrument with results from a more detailed measure (e.g., 24-hour recall) and (2) consistency between results from the instrument and results from biochemical measures of nutritional status.
  - *Sensitivity to Change.* This column indicates the magnitude of the difference over time (expressed as a percentage of the baseline level) that was detectable as statistically significant. The population in which the change was observed is noteworthy because a measure's sensitivity to change will vary among different populations. The information in this column can help estimate the sample size needed for a study. Data from prior studies about the percentage of an audience engaged in behavior before and after the intervention can be used to estimate sample size requirements for future studies.
- *Comparative Data.* This column describes comparative data (if available) that may be used to address the generalizability of evaluation findings.

The section that follows discusses these measures as well as short-term dietary recalls and food frequency questionnaires (FFQs) because of their practicality for use in program evaluation with free-living, low-income adults and adolescents. Recommendations are made to reduce reporting bias. Additional information on dietary assessment methods is available from other sources such as the National Cancer Institute (NCI).[8].

**Total diet measures.** This section describes two types of measures of total diet that have ready application to evaluations with low-income audiences: (1) dietary recalls and (2) FFQs.

***Dietary recall.*** The 24-hour dietary recall method is useful in determining the impact of dietary interventions on short-term food consumption of large groups (as opposed to individuals). It has many advantages. Owing to its lack of assumptions, it can be used for assessing mean intakes among diverse, heterogeneous, low-income groups. It is open ended; thus, its administration should alter eating behavior minimally.[3] It provides the educator with a "snapshot" of what an individual or group eats. Reviewing results with participants can possibly enhance education by generating interest, discussion, and self-examination. A 24-hour recall requires only 10 to 20 minutes to administer to individuals by trained interviewers and is therefore less expensive and less fatiguing than more detailed measures such as food records.[9] Doing dietary recalls in groups requires additional time and is more challenging. Despite the challenges, this is the primary means of assessing dietary quality and behavior change in established national programming for low-income audiences such as the Expanded Food and Nutrition Education Program (EFNEP).[10]

One primary disadvantage of the single 24-hour recall is that it is only scientifically valid when used with large samples. Because of the typical day-to-day variability in the foods

**Table 1.** Characteristics of instruments for measuring change in dietary quality.

| | | | | *Measurement Properties and Study Population* | | | | |
|---|---|---|---|---|---|---|---|---|
| *Indicator* | *Topics* | *Mode of Data Collection* | *Length (Items or Min)* | *Reliability (Cronbach's alpha; Test–Retest)* | *Validity* | *Sensitivity to Change* | *Comparative Data* | *References* |
| *Food frequency questionnaires* | | | | | | | | |
| BRFSS (CDC) | Fruits and vegetables (separately), juice<br>Dairy and fats<br>No specific foods listed | Telephone survey<br>Small group<br>Large group | 6 items<br>4 items<br>13 items | Pop: 49 whites, 43 African Americans, 53 Hispanics in low-income central city neighborhood[12]<br>Test–retest after 10–21 d, kappa[12]:<br>Fruit Veg<br>Total: .48 .20<br>Whites: .79 .07<br>African Americans: .31 .04<br>Hispanics: .46 .54 | Pop: 73 low-income Hispanics<br>Consumption of fruits plus vegetables to longer Block FFQ (r = .46)[13] | Not done; cross-sectional surveys | Annual state data for adults in homes with telephones; adults with less education[13,14] | Shea et al., 1991[12]; Serdula et al., 1993[13]; Serdula et al., 1995[14] |
| 5 A Day (NCI) | Fruits and vegetables (separately), juice<br>Only potatoes (fried and other) listed as specific foods | In person<br>Telephone survey<br>Small group<br>Large group | 7 items | Pop: 3737 rural African Americans<br>62% ≤ $20,000/year<br>α = .80–.92[15] | Related to longer Block FFQ | Change over 1 year ($p \leq .05$)[19] | Data for selected communities | Campbell et al., 1996[15]; Campbell et al., 1998[16]; Havas et al., 1997[17]; McClelland et al., 1998[18]; Campbell et al., 1999[19] |
| California Dietary Practices Survey | Fruits and vegetables (separately), beans, milk products, whole grains, meats, fats, fried foods, sweets | Telephone survey | 20 min | Pop: California telephone survey of adults<br>Not reported | Not reported | Not done; cross-sectional survey | Data every 2 years by age, sex, race/ethnicity | Foerster et al., 1999[20] |

**Table 1.** *Continued.*

| | | | | *Measurement Properties and Study Population* | | | | |
|---|---|---|---|---|---|---|---|---|
| *Indicator* | *Topics* | *Mode of Data Collection* | *Length (Items or Min)* | *Reliability (Cronbach's alpha; Test–Retest)* | *Validity* | *Sensitivity to Change* | *Comparative Data* | *References* |
| FFQ used in Women's Health Trial feasibility study in minority populations | Fruits, vegetables (considered as individual foods), grains, fat | Self-administered<br>In person or by mail | 100 items | Pop: 1015 women (28% African American, 16% Hispanic) 15% < $15,000[22]<br>Test–retest correlations (at screening) for fat (% energy): .37–.51<br>Correlations for other nutrients: .46–.62[22] | Correlation with 4-day food records: .15–.34[22] | Change over 6 mo ($p \leq .05$) | Not reported | Bowen et al., 1996[21]; Kristal et al., 1997[22] |
| Block Health Habits and History Questionnaire/ NCI | Fat, vitamins A and C; specific foods grouped into food groups, such as fruits, vegetables | Self-administered | 98 items (original); 60-item version developed later | Pop: 50% African American, 50% women (n = 85) in Michigan[23]<br>Not reported<br>Pop: Low-income African-American female outpatients (n = 91) in Atlanta[24]<br>Not reported | Correlation with 4-day diet: .42–.68[23]<br>Correlation with serum carotenoids: .45[24] | Not reported in low-income population | Epidemiologic data | Block et al., 1986[23]; Coates et al., 1991[24]; Slattery et al., 1994[25]; Block et al., 1992[26] |
| Quick Check for Fat | Total fat, saturated fat, cholesterol | Self-administered<br>Small groups | 2–3 min (for subjects); ~28 foods | Pop: 75 clerical workers<br>Test–retest correlations: .77–.81[27] | Related to NCI Health Habits and History ($p \leq .05$) | Not reported | Not reported | Schaefer et al., 1992[27] |
| 24-hour dietary recall | | | | | | | | |
| Many instruments | Food groups, nutrients | In person<br>Small group | 20–30 min | Pop: 58 low-income women with children[29]<br>Not reported | Correlation with serum carotene: .34[29] | Change over ($p \leq .05$) 3–12 months[29] | Nationwide Food Consumption Survey; CSFII for low-income populations | Thompson and Byers, 1994[28]; Murphy et al., 1999[29] |
| *Food behavior checklists* | | | | | | | | |
| California Food Behavior Checklist | Servings of fruits, vegetables<br>Food behavior (e.g., use of spreads) | In person<br>Telephone<br>Small group<br>Large group | 14 items | Pop: low-income women with children (n = 110)[29]<br>Not reported | Correlations with 24-hour recall: .28–.41 | Change over 6 sessions ($p \leq .05$)[29] | None | Murphy et al., 1999[29] |
| Modified Food Habits Questionnaire | How food is prepared, consumption of fresh fruit, fried chicken | Telephone survey | 38 items | Pop: 93 low-income women in urban Canada[30]<br>Test–retest over 1 wk: .84<br>$\alpha$ = .80–.92[30] | Not reported | Not reported | Not reported | Gray-Donald et al., 1997[30] |

**Table 1.** *Continued.*

| Indicator | Topics | Mode of Data Collection | Length (Items or Min) | Measurement Properties and Study Population: Reliability (Cronbach's alpha; Test–Retest) | Measurement Properties and Study Population: Validity | Measurement Properties and Study Population: Sensitivity to Change | Comparative Data | References |
|---|---|---|---|---|---|---|---|---|
| *Measures of physical activity/balancing intake* | | | | | | | | |
| BRFSS (CDC) | Physical activity | Telephone survey<br>Small group<br>Large group | 12 items | 49 whites, 43 African Americans, 53 Hispanics in low-income central city neighborhood[12]<br>Test–retest after 10–21 d, kappa: Total: .65; Whites: .57; African Americans: .77; Hispanics: .62[12] | Not reported | Not reported | Annual data for adults by state | CDC[31]; Stein et al., 1995[32]; |
| Physical Activity Questionnaire | Physical activity | In person | 20 min (40 items) | Pop: 69 Pima Indian adults[33]<br>Test–retest after 1 wk[33]: $\alpha$ = .76–.96 | Pop: 17 Pima Indian adults<br>Correlated with activity monitor: .62[33] | Not reported | Not reported | Kriska et al., 1990[33] |
| Physical Activity History (developed for CARDIA Study) | Physical activity | Telephone survey<br>In person | 13 items (5–10 min) | Pop: 5115 African Americans (54%) and white young adults[34]<br>Test–retest correlation: .77–.84[34] | Correlation with treadmill time[34]:<br>Male: .21<br>Female: .36 | Not reported | Not reported | Lewis et al., 1993[34]; Jacobs et al., 1989[35] |
| BRFSS (CDC) | Weight management | Telephone survey<br>Small group<br>Large group | 6 items | State samples of adults in households with telephone[31]<br>Not reported | Not reported | Not reported | Annual data for adults by state | CDC[31] |
| Youth Risk Behavior Survey | Weight management | In person<br>Small group<br>Large group | 4 items | Pop: grade 7–12 students (15% < $15,000)[37]<br>Test–retest after 14 d: .79[37]<br>Not reported | Not reported | Not reported | Annual data for youth by state | NCHS, 1994[36]; Brener et al., 1995[37] |

BRFSS = Behavioral Risk Factor Surveillance System; CDC = National Center for Chronic Disease Prevention and Health Promotion; FFQ = food frequency questionnaire; NCI = National Cancer Institute; CSFII = Continuing Survey of Food Intakes by Individuals; NCHS = National Center for Health Statistics; CARDIA = Coronary Artery Risk Development in Young Adults.

people eat, a single day's 24-hour recall is not a particularly sensitive measure for assessing individual or small-group dietary change. For smaller sample sizes, multiple days of 24-hour dietary recall are needed. This can be expensive and difficult to collect in community settings. Thus, participants are often asked to recall what they ate on the previous day only. Because of considerable dietary variation from day to day, the recalled day should be as representative as possible. Unfortunately, such a day may not exist. Studies with adolescents found that every day of the week should be recalled to acquire accurate data.[11] Studies with women showed that energy consumption is greater on the weekend than during the week.[38] To account for daily variability, a study based on a single 24-hour dietary recall requires a larger sample size than a study that gathers data on multiple days.

Dietary recalls typically result in under-reporting, and there is some evidence that under-reporting is more common among overweight individuals.[39] This may be a special concern for those working with low-income audiences, where overweight is more prevalent than in other subgroups of the U.S. population.[40] Researchers have also found that a 24-hour recall of a single meal by elderly participants underestimates calories actually consumed ($p < .05$).[41]

Other limitations of recall methods include the fact that many dietary assessment programs do not readily classify foods (or mixtures) into food groups, and, in some cases, the number of servings from the different food groups must be estimated by the participant or the nutritionist. This can be especially difficult when working with diverse cultures, cuisines, and literacy levels. Fortunately, some data analysis programs do exist to facilitate the process. For example, the EFNEP Evaluating/Reporting System (ERS) calculates food group consumption and was designed for use with low-income youth and families with young children. It has also been modified to enhance its usefulness for other nutrition education programs.[10] The Healthy Eating Index (HEI) assesses total dietary quality and variety and has been calculated for low-income audiences using Continuing Survey of Food Intakes by Individuals (CSFII) data, although the HEI has not yet been tested for usefulness in program evaluation.[42] Commercial software packages that classify foods into food groups are also available.[43–45]

***Food frequency questionnaires.*** FFQs are another recall method used to evaluate dietary change.[46] Compared with other recall methods, FFQs are relatively quick and inexpensive to administer. Because the early, more comprehensive FFQs were somewhat lengthy, briefer forms have been developed to save time and money without sacrificing validity and reliability.[46–50]

Participants responding to an FFQ report usual consumption over an extended period of time that is specified by the instrument (1 month or more). FFQs address the concept of daily variability in food consumption better than 24-hour recalls, but sufficient time must be allowed for dietary changes to occur before post-test FFQs are used to measure differences. Shorter-term community programs may therefore need a different type of dietary assessment.

Unlike food recalls, FFQs tend to overestimate consumption.[3] Since the number of foods in an FFQ has been shown to correlate positively with the level of overestimation, one might expect a shortened version to be more highly correlated with actual food consumption.[51] However, abridged forms of FFQs may not yield the level of detail needed to determine daily variation in nutrient and consumption patterns (e.g., they may not measure intake of dietary fat or cholesterol, new food products, infrequently consumed fruits and vegetables, or ethnic or regional foods).[52,53] FFQs must use an appropriate or meaningful inventory of the audience's commonly used foods to obtain valid and reliable data.[23] This may be of primary concern when the goal is to measure nutrients such as calcium, which is being added to more foods every day. Also, care must be taken to ensure that food names are consistently interpreted across diverse audiences. For example, in one study, some participants interpreted "tortillas" to mean fried tortilla chips, whereas other participants interpreted "tortillas" to mean uncooked flour or corn tortillas.[54] Kristal et al. suggested that special protocols that include participant training may be needed when using self-administered FFQs in minority or poorly educated audiences.[55]

Like the 24-hour recall method, limitations associated with FFQs also include participant difficulty in determining serving sizes and in assigning combination foods to a single category.[56] In low-income households, measuring cups may not be available for estimating serving sizes, but this problem can be alleviated by providing participants with two-dimensional food depictions or food models to represent amounts.[6,7,15,57] For telephone surveys, two-dimensional models can be mailed to participants prior to the call.

***Selecting and administering dietary assessment tools.*** The evaluation instrument selected depends on the purpose for reporting the measured outcomes, the degree of accuracy and type of data needed to fulfill that purpose, the skill of the staff, and the size, ability, and cooperation of the study population. For the low-income audiences, measurement tools should be easy to comprehend, quick to administer, sensitive to change, and appropriate to audience diversity. It is important to recognize the limitations of traditional methods used to measure dietary change in low-income audiences and to make adjustments when possible. Respondents may have limited reading, writing, and comprehension skills. They may be reluctant to report what and how much they eat, especially if they consider some foods to be of low status or if they have concerns that professionals might be judging their ability to care adequately for their children through the foods they provide. Fear that the children may be removed from the home might cause them to withhold or fictionalize responses.

Dietary assessment methods and instruments may achieve varying levels of validity and reliability among diverse populations. Kristal et al. found the FFQ less valid with African Americans than Caucasians ($p < .001$) and higher in validity among women with fewer than 15 years of education than those with 16 or more years of education ($p < .05$).[55] For ethnic or regional audiences, FFQs may need to be customized to include foods that are major contributors of nutrients in the ethnic or regional diet.[24,58,59] There is also concern that English-speaking participants may respond to FFQs (written in English) differently than Spanish-speaking participants respond to FFQs (written in Spanish) since significant differences in food choices have been shown between Latinos and others.[20]

**Consumption from Food Guide Pyramid groups.** The following sections discuss measurement instruments used with low-income audiences to assess consumption of foods from each group of the FGP. Additional details regarding each instrument are presented in Table 1. Consumption of a specific number of servings from each food group is typically used as a primary indicator of diet quality. Consumption of a variety of foods within each food group is also recommended. It is likely that variety within groups is not measured as well with FFQs as 24-hour recalls since all individual foods cannot be listed on FFQs. Finally, behaviors that have been shown to predict food group consumption can be used as indicators of dietary quality.

***Fruits and vegetables.*** Assessment of fruit and vegetable intake is considered a single construct for the following reasons: (1) many educational initiatives group them (e.g., the 5 A Day campaign[17]), (2) the nutrient profiles of the two groups are generally similar (i.e., relatively low in calories and fat and high in vitamins and minerals), and (3) most evaluation instruments identified in the literature grouped them.[17] A combined intake of five or more servings of fruits and vegetables per day is recommended. For example, the NCI 5 A Day Baseline Survey assessed combined fruit and vegetable consumption via an FFQ among a nationally representative group of U.S. adults.[60,61] Subsequently, NCI developed a seven-item core fruit and vegetable FFQ for use with adult populations.[15–18,60,61] Adapted from a Block FFQ, the seven items use broad inclusive categories, and the results correlate well with those from longer FFQs.[13,60,62–65] This same brief FFQ has also been used in the Special Supplemental Nutrition Program for Women, Infants and Children and has been validated in a number of U.S. populations, including low-income populations.[13,66–68]

Other FFQs used with low-income audiences include the Behavioral Risk Factor Surveillance System's (BRFSS) six-item fruit and vegetable module, which has been validated among low-income populations.[14,31] This module is similar to but not as encompassing as the NCI seven-item FFQ. The Block FFQ, designed to measure fruit, vegetable, fat, and fiber intake separately, has been validated with a variety of adult audiences, including low-income African Americans.[24] Other FFQs that have not been tested for validity and reproducibility with low-income audiences include two that measure fruits, fruit juices, and vegetables as three separate groups.[69,70]

***Bread, cereal, rice, and pasta.*** A number of questionnaires measure high-fiber cereal and/or bread consumption[28,64,69–71]; however, only one was validated with a low-income audience.[24] For consumption of whole grains among low-income Hispanics, it is useful to target whole-grain breads, corn tortillas, and whole-grain/high-fiber cereals. For instance, 64% of Hispanic adults in California (compared with 41% of Caucasian and 51% of African-American adults) consumed whole-grain/bread or corn tortillas on the day preceding the survey, with respondents in lower-income categories consuming slightly more than those in higher-income households.[72]

***Milk, yogurt, and cheese.*** Our literature search found no instruments that specifically assess dairy consumption with low-income audiences, but many FFQs include dairy products,[23,31,70,73,74] with some having been used with low-income audiences.[31,73] Kristal et al. tested a Food Behavior Checklist in the Women's Health Trial that included questions about milk consumption. General agreement between the checklist and the 24-hour recall was 92% when used in the general population of females; however, overall, the FFQ did not perform as well with African Americans and low-income audiences.[75]

***Meat, poultry, fish, dry beans, eggs, and nuts.*** A literature search found no survey instruments designed to specifically assess protein consumption, although assessment of protein intake is possible via a number of standard FFQs and diet recalls,[23,31,69] with one being validated with low-income audiences.[31] Note that for evaluations of protein consumption in low-income audiences, dry beans should be included in the analysis since they are frequently consumed by some ethnic groups within the low-income audience. The FGP classifies dry beans with the meat group but also approves counting them as vegetables.

***Fats, oils, and sweets.*** Potential indicator foods that may be responsible for a large proportion of total and saturated fat consumption might include whole milk, deep-fat fried foods, fried snack foods, pastries, rich desserts, regular ground beef, and processed meats.[76] The full Block FFQ includes most of these.[23] Briefer FFQs based on the leading food sources of fat identified in the Second National Health and Nutrition Examination Survey (NHANES II) are also available[76] but have not been validated for use with low-income audiences.[28] From 1990 through 1996, the BRFSS included an FFQ, similar to the Block fat screening questions, focused on animal products and validated against more extensive dietary interviews with five demographically diverse population seg-

ments.[31,77] This is inappropriate when the sample size is limited or for populations with diets substantially different from the typical U.S. diets, such as the low-income Hispanic women in this study.

The Quick Check for Fat, a quantitative FFQ covering 28 types of high-fat foods with portion sizes illustrated, is available in Spanish and includes Mexican-American foods; however, it needs to be validated for low-income audiences.[27] It gives somewhat higher estimates of fat calories than other surveys but is able to rank persons by relative fat intake and is stable with repetition.[23] A comprehensive review of dietary fat index questionnaires has been published that includes validity and reliability results for 16 questionnaires, varying in size from 8 to 49 items per assessment. Two of the 16 have been validated with low-income audiences, and one index has been validated with Mexican-American adults.[78]

Dietary practices or behaviors associated with lower-fat diets can also be monitored.[30,79–81] Kristal et al. developed a questionnaire to assess dietary behavior related to fat intake. It explores low-fat diet patterns by asking about the exclusion, replacement, substitution, and modification of fat.[81]

The most recent form of this questionnaire explores diet patterns related to fiber and fat.[71] Neither of these has been validated with low-income audiences. Also, Kristal et al.[82] developed and evaluated a short questionnaire about fat intake that can be used to make rapid assessments, which may be useful when time is limited. Practices such as eating bread without spreads, adding no butter or margarine to vegetables, consuming fruit for dessert, and using low-fat salad dressings are correlated with lower fat consumption among women with a variety of incomes. This questionnaire includes items on the type of milk and cheese eaten, how often fried foods and regular salad dressings are consumed, and how often butter, margarine, oil, or cream is used in preparing meals.[82]

The FGP does not quantify a recommended intake of added sugars, but this can be determined by considering sample diets containing the recommended number of servings from each food group. Calculations suggest that daily intake of added sugars should be limited to about 6 to 18 teaspoons for a 1600- to 2800-calorie diet, respectively.[83] This amounts to 6 to 10% of energy consumed (assuming 1 teaspoon of sugar is 4 g).[84] Current estimates indicate that added sugar consumption averages 16% of energy consumed by Americans aged 2 and older.[85] Specific measures designed to assess added sugars were not found in the literature, but standard measures that include indicator items, such as soft drinks, can yield information on consumption of added sugars.

***Measuring behavioral mediators of consumption.*** Behavior-specific antecedents to behavior change (such as predisposing, enabling, and reinforcing factors) can be measured for promotion of behavior change and program evaluation.[86–88] For example, activities targeting predisposing factors can be designed to raise awareness about diet and health relationships and to give feedback to motivate participants to start changing behavior.

Food preferences, behavior intentions, and sense of self-efficacy about making dietary changes have also been associated with changes in consumption of fats and sugars.[87] However, this review did not find examples in the literature validated with low-income audiences.

Stages of change measures that predict food consumption can be used as an antecedent to the adoption of specific behaviors.[16,29,89–91] Stage of dietary change measures what people think about their eating habits and their interest in change.[88,89] In an ideal application of this model, a nutritionist could assess a client's stage and then deliver a specific sequence of interventions to move that client through successive stages.[89] Studies often include stage of change as a component of dietary assessment.[89,91] Measures must be tailored to the specific foods targeted by the intervention as people may be at different stages of change for different foods.[92]

## WEIGHT MANAGEMENT PRACTICES AND PHYSICAL ACTIVITY

It has long been recognized that body weight and PA are important factors in maintaining health and quality of life. Maintenance of a healthy weight requires that both sides of the energy balance equation be addressed (i.e., proper nutrition for appropriate energy intake and PA to burn excess calories and build healthy lean muscle mass).[93] In fact, both body weight, measured as body mass index (BMI), and PA have been highlighted as nutritional concepts in the 2000 Dietary Guidelines for Americans.[2] The Guidelines encourage people to determine their BMI and to manage their weight. These concepts were emphasized in response to the growing prevalence of obesity in the United States, which represents a potential health threat to millions of Americans.[94] Potentially, pre- and post-BMI could be used in program evaluation regarding weight management.

Weight management may be an especially important concept to convey in nutrition education programs for low-income participants since research suggests that individuals from lower-income backgrounds are at higher risk for adult overweight, obesity, and affiliated conditions and chronic diseases.[40,94–97] CSFII 1994–1996 data indicate that, among low-income populations, women who receive food stamps are more likely than non–food stamp participants to be overweight.[40]

To reduce the prevalence of obesity among low-income groups, policy makers have recommended that an incentive system be developed to encourage food stamp recipients to purchase healthful foods and that government agencies do more to make PA attractive and convenient to food stamp clients.[98] Currently, 60% of American adults are not physically

active on a regular basis, and 25% are not active at all, although there is substantial variation by gender, race/ethnicity, age, and income.[87] Therefore, it is no surprise that the prevalence of obesity in the U.S. adult population has increased.[95] Accordingly, the following sections review instruments available to measure practices related to weight management and PA.

**Measuring weight management practices.** Although it may not always be feasible to collect data regarding body fat (or even weight), it can be useful to gather data on healthy and unhealthy weight management practices or behaviors since they are closely linked to obesity, diet, and PA. Healthy weight management behaviors include increasing the frequency, intensity, and duration of PA; increasing fruit and vegetable intake; and decreasing fat and energy consumption. Unhealthy weight management practices include fasting or skipping of meals, self-induced vomiting, binge eating, and use of diet pills, appetite suppressants, or laxatives. Indicators of weight management variables also include items assessing an individual's perceived weight and dieting status.

Although no measures of weight management practices were found for use specifically with low-income audiences, dieting status and selected weight management practices have been measured in population-based studies with adolescents or adults. These include the Minnesota Adolescent Health Survey, National Longitudinal Study of Adolescent Health, Youth Risk Behavior Survey (YRBS), BRFSS, and National Health Interview Survey.[99–105] In addition, several studies have been conducted on weight loss practices, such as the Pound of Prevention study,[106] and the longitudinal study of eating disorders among adolescent females.[107] There is also a set of knowledge and behavior questions that have been shown to assess the impact of weight control programming across the United States with diverse audiences and diverse programs.[108] The results of several of these and other studies have been published.[109]

In examining the dieting behaviors and socioeconomic status of adolescent females, Story et al. suggested that future research focus on the validity of self-reports of dieting and weight control behaviors in different ethnic subgroups.[110] Others reviewing the literature related to eating behaviors among minority groups stressed the need for focusing on the effects of racism in the development of eating disorders.[111]

**Measuring PA.** Measuring PA typically involves having subjects complete a checklist of specific PAs (such as occupational, leisure time, or household activities). Respondents recollect the amount of time (and sometimes intensity) spent doing each activity over a specified time frame, such as the previous month.[112] Shorter, more general scales ask the number of occasions a respondent engaged in PA (often separating activity into vigorous, moderate, or mild). PA measures have been used in population-based surveys including the NHANES III, YRBS, BRFSS, and Multiple Risk Factor Intervention Trial.[12,36,113–115]

The reliability of PA scales has been investigated in the BRFSS and YRBS.[12,37,115,116] The questionnaires were developed for specific studies and validated with predominantly white samples, with a few exceptions. Some researchers have described a theoretical model to articulate cognitive theory in relation to survey questions concerning health behavior and to identify potential sources of potential response bias resulting from racial or ethnic cultural experience. They have suggested several ways in which the validity of questions about risk behavior can be improved for culturally diverse groups. These include using interviewers of the same racial or ethnic group or testing questions for potential racial or ethnic bias before using them.[117] Some PA measurement tools have been used or validated with population subgroups and racial and ethnic minorities.[34,37,118–121] These include the Paffenbarger, Physical Activity Questionnaire[119] and CARDIA Physical Activity History.[120,121]

**Measuring antecedents to PA.** Several measures have been used to assess antecedents to PA. These include social influences or norms, self-efficacy, beliefs about the consequences of being physically active, and intention to be physically active.[122–124] Behavioral antecedents have been applied in the development of theory-based PA interventions. For example, one program was tailored to individual readiness of participants to hear certain messages about PA, depending on their stage of change, and involved the identification and resolution of barriers to PA.[125]

## IMPLICATIONS FOR RESEARCH AND PRACTICE

**Dietary intake.** There is a critical need for studies to fill gaps in our knowledge about how to measure food intake among low-income and minority program participants. These are described below:

- Validation studies of measures of food consumption. It is important to determine if change in consumption of selected foods (called indicator foods) can be used as a proxy for change in total food consumption (e.g., does milk consumption predict total dairy consumption?). It is also important to determine how well general FFQ questions about the number of servings consumed per food group correlate with more detailed measures of consumption (e.g., diet records or recalls).
- Studies to determine whether changes in antecedent variables such as self-efficacy, food preferences, perceived barriers, and knowledge or stage of change can be used to predict change in actual food behavior.
- Studies of regional, age, and racial/ethnic differences that influence interpretation of items on questionnaires that measure food intake.
- Better methods of measuring portion sizes. Portion sizes are not necessarily synonymous with the FGP serving

sizes.[56] Also, few instruments for measuring consumption employ units used in education guidelines.[126]
- Ways to minimize respondent bias. For example, the number of servings reported in pre- and postintervention surveys may change owing to increased knowledge of the food themselves and of serving sizes rather than a change in consumption per se.
- More comprehensive measures of intake of whole grains, high-fiber cereals, and dry beans/legumes.
- Assessment of the validity and reliability of proxy measures for percentage of energy from fat. A complete dietary assessment is needed to assess the percentage of energy from fat, making it difficult to gauge progress against public health goals often stated in terms of fat as a percentage of total calories.
- Evaluation of innovative ways to look at consumption. For example, if a program changed our paradigm from trying to attain an average number of servings of fruits and vegetables per day to attaining a percentage of days on which five or more servings were consumed, then the issues to be faced in the reliability of assessment would be very different.[126]
- Research to determine the optimal data collection approaches to use when evaluating nutrition education interventions with low-income audiences. Potential approaches include face-to-face interviews, self-administered or assisted surveys, touchscreen computer surveys, and other methods.[127]
- Research to determine whether traditional pre- and posttesting should be used with this audience and, if so, under what circumstances?

**Weight management and PA.** Further research on methodologic issues related to weight control practices and PA among groups is needed, including the following:

- Studies establishing the reliability and validity of instruments measuring self-reported weight loss practices when used with various low-income, sociocultural, and racial/ethnic groups.
- Identifying factors associated with the success of weight management attempts, particularly the role of socioeconomic status. For example, one study indicated that low-income women received less support when they attempted to diet and engaged in worse diet practices than higher-income women.[97]
- Additional explorations regarding the role of ethnicity and social status in perceptions of body satisfaction and weight management practices.
- Reliability and validity of PA measures. Low-income, elderly, and minority populations have been under-represented in previous studies of the reliability and validity of PA measures.
- Research on the applicability of PA measures to diverse ethnic/socioeconomic groups.
- Research identifying determinants of PA including behavioral antecedents and stage of change.

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# Measures of Food Insecurity/Security

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**ABSTRACT** Nutrition education has the potential to play an important role in ensuring food security and improving nutritional status. Therefore, food security is recommended for inclusion in nutrition education evaluation efforts. Considerable progress has been made in developing brief tools that can be used to measure food security at the household level. These tools are reliable in population-based surveys, and some studies have found that measures of food security are associated with nutrient intake. Hence, these tools can be valuable in monitoring, in community needs assessment, and in planning. These tools may also have the potential for use in evaluating nutrition education activities; this potential will be enhanced by research into the capacity of these tools to identify changes within households over time as a result of nutrition education and their sensitivity and reliability in doing so.

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## FOOD SECURITY AND NUTRITION EDUCATION

Food security has been defined as

> Access by all people at all times to enough food for an active, healthy life. Food security includes at a minimum: the ready availability of nutritionally adequate and safe foods, and an assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies).[1]

Food security may best be conceptualized as a goal and is most often measured by the absence or low prevalence of hunger, specifically, and of food insecurity more broadly. In this approach, hunger—"the uneasy or painful sensation caused by a lack of food"—is not distinct from the condition of food insecurity but represents the more severe form in which the condition is experienced—"a potential, but not necessary, consequence of food insecurity."[1] Households experience food insecurity in the most basic sense when their resources are inadequate simply to obtain "enough food" to meet basic needs—the condition that, in its severe form, results in hunger for household members.

Although this is the core element of the concept, the broad conceptual definition also calls attention to several additional dimensions of the phenomenon of food insecurity: "the limited or uncertain availability of nutritionally adequate and safe foods or the limited or uncertain ability to acquire acceptable foods in socially acceptable ways."[1] It is the core element of the definition—enough food to meet basic needs as perceived and experienced within the household—that has been most carefully quantified in current measures of food security. There is currently no general agreement about how to best incorporate measures of food safety, dietary quality, or the availability of food through socially acceptable channels.

Hunger and food security have been identified as national priorities that, in principle, should have particular relevance for nutrition education.[1] For instance, the U.S. Department of Health and Human Services has adopted the goal of increasing the prevalence of food security among U.S. households as one of the health objectives for the nation for the year 2010.[2] Educators working with vulnerable populations recount stories to support the premise that food security can be increased through nutrition education. However, this working assumption has not yet been proven, and systematic testing of the proposition remains a high-priority area for research. In the absence of clear empirical evidence, judgments can differ on the potential effectiveness of educational interventions in improving food security. For instance, in a review of an earlier draft of this article, Dr. Chris Hamilton of Abt Associates (personal communication, January 21, 2000) commented,

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**Table 1.** Characteristics of food security/insecurity measures.

| Indicator | Ref. No. | Methods of Data Collection | Length (Items or Minutes) | Reliability (Cronbach's alpha; Test–Retest) | Validation | Sensitivity and Specificity[a] | Comparative Data |
|---|---|---|---|---|---|---|---|
| Single items for measuring food security/insecurity at the household level | | | | | | | |
| CSFII and NHANES III food sufficiency question | 15, 16, 17 | In person, telephone, group | 1 item | No test/retest reliability available; Cronbach's alpha = NA (single question) | The positive responses were associated with higher family intake of kcal, protein, vitamins A, C, and E, B vitamins ($B_6$, folate, riboflavin, thiamine), and minerals (calcium, iron, magnesium, phosphorus, zinc) on NHANES III[16,17] | Sensitivity: 32% Specificity: 90% in NHANES III[17] | National data available |
| EFNEP Reporting System—Behavior Checklist | 43 | In person, telephone, group | 1 item | $\alpha$ = NA (single question) | Not reported | Not reported | National data available annually |
| Concern About Food Security | 19 | Telephone | 1 item | $\alpha$ = NA (single question) | Not reported | Not reported | Data from 8 states |
| Scales for measuring food insecurity at the household level | | | | | | | |
| CCHIP | 7, 20 | In person | 8 items | $\alpha$ = .80–.89 | Index strongly associated with economic and sociodemographic variables, reliance on coping strategies, and health problems with children[7,20] | Not reported | Not reported |
| Radimer/Cornell questionnaire | 24–27 | In person, telephone, group | 13-item subscales: household (5) women (4) children (4) | $\alpha$ = .84–.86 | Correlated with risk factors for hunger, consequences of hunger, and hunger indicators from other surveys; correlated with total amount of food in household and weekly fruit and vegetable consumption; criterion measure[25–27] | Sensitivity: 89% Specificity: 63%[27] | Upstate New York, Quebec,[26] CPS-based national data, 1995–99 |
| U.S. Household Food Security Scale | 10, 11, 14, 26–30 | In person, telephone, group, self-administered | 18 questions[b] | $\alpha$ = .74–.93 | Significant relationship to poverty income ratio, weekly food expenditures, the food sufficiency question,[11,30] and nutrient intake (energy, protein, vitamin A, calcium, iron, and minerals) in women visiting food banks | Not reported | CPS-based national and state-level data, published annually[d] |
| Six-item short form of the Household Food Security Scale | 14, 37, 38 | In person, telephone, group | 6 questions[c] | Correctly classifies | Not reported | Not reported | CPS-based national data |
| Scales for measuring food security at the community level | | | | | | | |
| Second Harvest NFBNAs | 44 | In person | 20 min | Not reported | Not reported | Not reported | Selected cities published regularly: www.secondharvest.org. |
| U.S. Conference of Mayors' Survey | 45 | Mail survey | 15 questions to health departments | Not reported with many details | Not reported | Not reported | Selected cities: www.usmayors.org; published annually |

[a]Sensitivity indicates how well a measure identifies the individuals who have a condition (i.e., "true positives"); specificity indicates how well a measure avoids incorrect classification (i.e., "false negatives").
[b]With recommended two-stage internal screeners, most respondents are asked 5–11 questions (households with children) or 3–8 questions (households without children), depending on skip patterns. Estimated average interview time = 2–4 minutes, depending on the level of food insecurity in the population sampled.
[c]With an internal screener, most households (with or without children) are asked 3 questions.
[d]See page 15 for a listing of other national surveys including the Core Module for Food Security Data Collection.
CSFII = Continuing Survey of Food Intakes by Individuals; NHANES III = Third National Health and Nutrition Examination Survey; EFNEP = Expanded Food and Nutrition Education Program; CCHIP = Community Childhood Hunger Identification Project; CPS = Current Population Survey; NFBNA = National Food Bank Network Agency Survey.

Food insecurity is presumed to arise principally from economic constraints (including both household income and the competing demands of household needs other than food), which are beyond the reach of nutrition education. Nutrition education may teach people how to maximize the nutritional value they obtain with the resources they have available, but one would expect this effect to be small relative to the effect of what they have available.

Conversely, it can be argued that nutrition education can help low-income families to shop wisely and make decisions about nutritious food consumption and management that can help to increase food security. For instance, studies in the developing world have shown that an educational component can increase the effectiveness of food aid in raising the nutritional quality of diets.[3,4] Therefore, the ability to measure the level of food security should be useful to those who are working (1) to identify, target, and screen groups and households that might benefit from educational interventions; (2) to develop and test instruments that may be sensitive enough to register the effects of interventions on food security; and (3) once such instruments are proven, to use them in evaluating the effectiveness of nutrition education interventions in increasing food security and in improving the nutritional quality of diets.

The conceptual and developmental work in creating measures of food security has been described in other documents.[5–14] This article uses the term "food security" and "food insecurity" to refer to the positive and negative ends of the same conceptual measure. It discusses instruments for measuring food security that are currently available for potential use in nutrition education and social marketing programs with low-income populations. It describes the available tools and what is known about their reliability and validity and the practicality of their use. The article also discusses knowledge gaps and research needs that exist in this area, thus helping to lay the groundwork for a research agenda in this field.

This article focuses on measures for assessing food security in low-income populations at the individual and household levels. These items are summarized in Table 1 and discussed in the sections that follow. There is useful information about three single-item indicators and four scales that are currently available for measuring individual and household-level food security. It can also be important to be able to assess changes in food security at the community level. For this purpose, the most basic measure is the prevalence of food security and hunger, at well-defined levels of severity, among the households and household members residing in the community. Beyond that basic element, however, there is not yet general agreement on the many other potential aspects that might be included in the concept and definition of "community food security." Development work is under way that may eventually achieve accepted definitions and measures of community-level food security, but none is available at present.

## INSTRUMENTS AVAILABLE TO MEASURE FOOD SECURITY AT THE HOUSEHOLD/ INDIVIDUAL LEVEL

**Single indicators.** Three single-item indicators are commonly used for measuring household food security.

***The food sufficiency question.*** One indicator, commonly referred to as "the U.S. Department of Agriculture (USDA) food sufficiency question," has appeared on every USDA food survey since 1977, including the Nationwide Food Consumption Survey (NFCS) and the Continuing Survey of Food Intakes by Individuals (CSFII):

Which of the following statements best describes the food eaten in your household:

1. Enough of the kinds of food we want to eat,
2. Enough but not always the kinds of food we want to eat,
3. Sometimes not enough to eat, or
4. Often not enough to eat.

An abbreviated version of this question was used on the Third National Health and Nutrition Examination Survey (NHANES-III; the planned NHANES-IV will use the original USDA version). The NHANES-III version deleted the second (food quality) response category. The USDA has collected both versions of the question in its annual Food Security Supplement to the Census Bureau's Current Population Survey (CPS). Analysis has shown that the two forms of the measure produce significantly different results. When the second response option is deleted, the third response—"sometimes not enough to eat"—nearly doubles in frequency (personal communication, Andres M, Bickel G, USDA, February 2000).

The USDA four-part version of the question was validated against nutrient intake by Christofar and Basiotis[15] and, subsequently, with much stronger findings, by Rose and Oliveira.[16,17] The findings from these studies indicated that individuals whose responses indicated hunger (e.g., 3, "sometimes," or 4, "often not enough to eat") were significantly less nutrient sufficient in the percentage of recommended dietary allowances (RDAs) that they consumed compared with those whose responses indicated no hunger (i.e., responses of 1 or 2). The Rose-Oliveira study found a strong relationship in the 1989–1991 CSFII among 3800 women, aged 19 to 50, for energy, protein, vitamins (A, C, E, $B_6$, niacin, and riboflavin), and minerals (calcium, phosphorus, and magnesium). This relationship was observed among 2200 elderly respondents for energy and for vitamins (A, $B_6$, folate, niacin, riboflavin). There was also a relationship between the food security reported by 1380 mothers and their reports of the consumption by their preschool children for energy, vitamin $B_6$, iron, and magnesium. These relationships were strongest among elderly populations; respondents aged 65 and older who indicated that they "sometimes" or "often" did not have enough to eat during the previous 30 days were between 2

and 3 times less likely than those who had enough of what they wanted to eat to have consumed 50% of the RDA for calcium and for vitamins A and E and the B vitamins. By comparison, 19- to 50-year-old women who indicated that they "sometimes" or "often" did not get enough to eat were around 1.5 to 1.8 times less likely to have consumed at least 50% of the RDA for vitamins A, C, and E and the B vitamins.

***The Expanded Food and Nutrition Education Program (EFNEP) Evaluating/Reporting System question.*** The second single-item indicator is used in the EFNEP reporting system.* Development of the behavior checklist on which this question is based began with focus group research in 1992. This single question about food security asks,

How often do you run out of food before the end of the month?

1. Do not run out of food,
2. Seldom,
3. Sometimes,
4. Most of the time, or
5. Almost always.

Dr. Ruby Cox, EFNEP Coordinator for Virginia Tech Cooperative Extension Service (personal communication, February 5, 1998), indicated that there may be a practical problem with this question. Although people orally report to their educators that food security is an issue for them, they are often unwilling to write this on their behavior checklist at program entry when they do not know or trust their educator. By the time they have finished their class session and are completing their post-tests, they may be more willing to admit their true food security status. Therefore, improvements in this area may be underestimated. The first author of this article has also found this to be the case with program participants in Minnesota and New Jersey. No reliability or validity data are currently available for this particular question.

To help address this gap, preliminary analysis was conducted (personal communication, Hersey J, Research Triangle Institute, and Anliker J, Health Systems Research, February 2000) to investigate the association between "running out of food before the end of the month" and dietary quality in a sample of 5139 nonpregnant, nonlactating, low-income women in four states (California, Oklahoma, South Dakota, and Virginia) who participated in the EFNEP during 1999. Although the sample was not statistically representative of all ENFEP participants, it did permit investigation of the relationships among key variables. Preliminary analyses indicate a very modest, though statistically significant, relationship between "running out of food before the end of the month" and dietary quality based on a single 24-hour recall (controlling for age, family income, family size, and week of the month in which the 24-hour recall was obtained).

In the longitudinal subsample of 2360 participants, the proportion of low-income women who "sometimes," "most of the time," or "almost always" ran out of food before the end of the month decreased from 52% to 28% over the course of 6 to 12 months, suggesting that nutrition education can have an effect on food security. However, without a control group, it is difficult to interpret how much of this improvement might be attributed to program participation and how much to participants offering socially desirable responses. Moreover, a California study found no differences over time between an intervention group of 78 low-income women with children who participated in a series of six 1-hour nutrition education classes and a control group of 19 low-income women in the frequency with which they reported "running out of food before the end of the month" or in the frequency with which respondents answered affirmatively to the question, "Do you worry whether your food will run out before you can buy more?"[18]

***Concern about food security question.*** The third single-item indicator is the question on concern about food security that is included in the social context module of the Behavioral Risk Factor Surveillance System.[19] This item asks for a "yes" or "no" response to the question, "In the past 30 days, have you been concerned about having enough food for you or your family?" This item has been included on telephone surveys conducted by eight different states since 1996. There is no reported information about the reliability of this item or the sensitivity of the item to changes within individuals over time. Although there have been no studies of the validity of the item, the pattern of concern among various subgroups is consistent with the expectation that food insecurity is more common among low-income populations. A series of random digit dialing telephone surveys in eight states (Kansas, Louisiana, Maryland, Montana, Massachusetts, Pennsylvania, South Carolina, Virginia) found that the prevalence of concern about food security was significantly higher among adults who were unemployed, had less education, and had lower annual household income.[19]

In addition, concern about food security was significantly higher among adults who reported lower intake of fruits and vegetables; analysis conducted for this article with the aggregate sample of 26,489 adults in eight states between 1996 and 1998 indicated that the level of concern about food security was 10.1% among respondents who reported eating less than one serving of fruits and vegetables per day and 7.5% among respondents who reported eating one to two servings of fruits and vegetables per day, compared with 4.6% among those eating three to four servings and 3.9% among respondents reporting eating five or more servings. Similarly, concern about food security was significantly higher among adults who reported that their general health was only fair or poor (10.8%) than among those who reported their general health as good (7.2%) or excellent or very good (4.0%).

*Although this article discusses the single-item food security question in the core checklist, optional questions in the master question database include the short form of the Household Food Security Scale (discussed below), which programs can draw on for more in-depth evaluation.

Scales that have been developed to measure the severity of food security and hunger at the individual and household levels are another type of food security and hunger measure identified for potential use in program evaluation. There are three broad scales.

**Community Childhood Hunger Identification Project (CCHIP) hunger index.** One of the first scales developed to measure hunger in families with at least one child under the age of 12 was the CCHIP hunger index.[8,20] The scale comprises eight questions that indicate whether adults or children in the household are affected by food insufficiency owing to constrained resources. On this additive scale, a score of 5 or more affirmative answers indicates a food shortage problem affecting everyone in the household, including children. A score of 1 to 4 indicates that the family is at risk of hunger.

***Reliability and validity.*** Focus groups, expert[2] assessments, and extensive pretesting were carried out in the developmental stages of the index.[20] An initial testing of the index in Washington State found the scale to have a reliability coefficient (Cronbach's alpha) of .86.[7] Subsequent testing in five other states found reliability coefficients ranging from .80 to .89, indicating excellent reliability.[20] Research has examined the relationship of the scales to economic and sociodemographic variables, reliance on coping strategies, and health problems in children; the index was strongly associated in the expected direction with all of these variables.[21–23]

***Use.*** The short form of the CCHIP scale can be found in *Food Security in the United States: A Guidebook for Public Issues Education*.[9,23] This simple eight-item version of the questions with "yes/no" responses is quickly and easily administered in face-to-face interviews. The complete version of the CCHIP questionnaire includes a series of four questions, with skip patterns, for each scale item. These questions measure the frequency and duration of each such experience—the number of months' occurrence within the past year and number of days' occurrence within the past month. For this longer version, more interview time is required, but it has been widely used in CCHIP surveys throughout the country without complaints from respondents. Scoring of the eight-item scale is simply a matter of counting the number of questions that received "yes" responses and comparing this total to the guidelines provided. Interpretation of the full questionnaire is more complex but provides information on the frequency and episodes of food insecurity and hunger.

**Radimer/Cornell measures of hunger and food insecurity.** At about the same time that the CCHIP was being developed, Radimer and colleagues at Cornell University were conducting in-depth interviews with 32 women with children in rural and urban areas of Central New York to develop definitions, a conceptual framework, and items to measure hunger and food insecurity in households with children.[24] A set of 30 items was administered to a stratified random sample of 193 women from this geographic area, oversampling from low-income households. Based on the results of factor analysis and psychometric analysis, 18 items were eliminated. The 12 remaining items formed three subscales, each containing four items. The subscales covered household food insecurity, women's food insecurity and hunger, and child hunger. As the scale evolved, a thirteenth question was added to measure the quality of household food supplies. Taken together, the three subscales correspond loosely to a single overall scale for the severity of food insecurity and hunger within the household.

***Reliability and validity.*** The reliability coefficients for the subscales were .91 for the household subscale, .92 for the women's subscale, and .89 for the children's hunger subscale. Each subscale correlated in expected ways with risk factors for hunger, consequences of hunger, and hunger indicators from other surveys. To validate the Radimer/Cornell measures of hunger and food insecurity, it was administered as part of a detailed survey of 189 lower-income households in a rural county of upstate New York.[25]

Total household food supplies and the amount of food in all of the major categories progressively declined with an increase in the severity of food insecurity, as measured by this scale. Weekly consumption of fruits and vegetables also declined. Both findings indicated that the measure was valid for differentiating among groups of households experiencing increasingly severe food insecurity and hunger. Frongillo has examined the performance of the Radimer/Cornell items across five different surveys, including one with a French-speaking population in Canada and a primarily Hispanic population in Connecticut, and has found consistency of patterns in affirmative responses across all populations.[26]

Owing to the extensive nature of the data collected in the survey described above, the Cornell group has been able to further evaluate the validity of three different food insecurity and hunger measures: the CCHIP hunger index, the Radimer/Cornell measures, and the NHANES III version of the food sufficiency question.[24–27] This research determined the sensitivity and specificity of each measure for identifying households that truly appeared to be experiencing a problem. The Radimer/Cornell and the CCHIP measures had good specificity compared with a criterion measure, defined by interviewer consensus, based on in-depth personal interviews about family nutritional circumstances (i.e., 63–71% of those deemed to be food secure by this criterion were correctly classified) and excellent sensitivity (i.e., 84–89% of those deemed food insecure were correctly classified). The NHANES III version of the food sufficiency question had excellent specificity but poor sensitivity (only 32% were correctly classified).

***Use.*** The Radimer/Cornell scale can be found in *Food Security in the United States: A Guidebook for Public Issues Education*.[23] The items have been widely used in face-to-face

interviews, with no complaints of respondent burden. Both of these items and the CCHIP scale could be reformatted for self-administered questionnaires for individuals who are able to read; they could also be administered over the telephone. Scoring is a matter of counting the number of items that received an "often" or "sometimes true" response and comparing this number to the numerical cutoffs in *Food Security in the United States.*[23]

**U.S. Household Food Security Scale.** In recent years, the most widely used scale for measuring household food security and household members' hunger is the U.S. Household Food Security Scale, developed by the federal interagency Food Security Measurement Project. Using data from the 1995 CPS, an 18-item scale was developed to measure the level of severity of food insecurity and hunger experienced within the household during the preceding 12 months. Item response scaling procedures, using a Rasch model to develop interval scale points, were used to develop a scale of the severity of food problems as experienced by the household, depending on the household's overall pattern of response to the full set of questions. However, in practice, the method of scoring households is as simple as counting up the total number of affirmative responses to the scale questions, properly coded, and looking up the household's scale score in a standard table of values derived from the national CPS data. The food security scale assigns each household a scale value ranging from 0 to 10, with 0 indicating no evidence of food insecurity and scores close to 10 indicating cumulative evidence of the most severe degree of food sufficiency problems that are observed in U.S. conditions.

The food security scale provides a continuous measure of food insecurity severity levels, which can be important in associative analyses seeking to detect relatively subtle effects, that is, relatively slight movements along the scale. Using scores, households can be classified into one of four food security status categories:

1. *Food secure*—households with no or minimal evidence of a problem
2. *Food insecure without hunger*—households with concerns and adjustments to food management (e.g., reduced dietary quality) but little or no reported reduction in the quantity of food intake by household members
3. *Food insecure with hunger*—households in which adults have reduced food intake to the extent that they have experienced hunger
4. *Food insecure with severe hunger*—households in which children have reduced food intake and adults report going whole days with no food owing to a lack of resources

The food security status of a household measured by this instrument can be used as a continuous scale score; alternatively, the score can be used to classify households in the categories above using the coding direction for the instrument.[14]

***Reliability and validity.*** The 12-month scale has been shown to have good reliability, with a reliability coefficient of .81 for households with children and .74 for all households (extreme values that would inflate the reliability coefficient were omitted).[28] Scale scores also relate significantly to the poverty-income ratio (income relative to the poverty line), weekly food expenditures, and the USDA food sufficiency question in the expected ways, indicating validity.[29,30] Independent research has shown a strong association between the measure and nutrient intake levels in a stratified random sample of 145 women in families who used food pantries in Toronto.[31] Analysis of 3 nonconsecutive days of 24-hour recall data found that women who were classified as food insecure with severe hunger consumed 21% less energy, 28% less iron, 3% less proteins, and 45% less vitamin A than low-income women in whom hunger was not evident. Women who were food insecure with moderate hunger consumed about 14% less energy, 18% less protein, 20% less iron, and 56% less vitamin A than women in whom hunger was not evident.

An additional form of indirect validation of the core module Food Security Scale rests on its correlation with the single-item food sufficiency question, "Which of the following statements best describes the food eaten in your household: (1) Enough of the kinds of food we want to eat, (2) Enough but not always the kinds of food we want to eat, (3) Sometimes not enough to eat, or (4) Often not enough to eat," which, in turn, was found to be strongly associated with greater nutrient intake on the CSFII.[16,17] On the other hand, initial analysis of a 1996 survey of Food Stamp Program households failed to replicate the earlier findings (indeed, results indicated that households that reported being food insecure during the past year actually had more nutrients available at the time the study was conducted).[30] Interpretation of this study is complicated by the inconsistency in the time periods used for comparison: the study compared average levels of nutrients available to Food Stamp Program households based on a 7-day food use survey with the measure of food security over the past 12 months. Nonetheless, study authors suggested that a closer look at variability over time in food security merits consideration.

***Use.*** The core module–based Food Security Scale is the most comprehensive instrument yet developed for measuring food security and hunger in U.S. households and population groups. The simple categorical form of the measure is useful for monitoring population trends in food security status since it tracks the prevalence of food security at several well-defined levels, consistent over time and across population subgroups. Recent research has shown the scale to be highly stable over time and robust across diverse population groups.[31,32] The core module was designed to provide a consistent measure for state- and local-level research and monitoring uses and to play a role in national-level monitoring. One benefit of the consistency of the method is that a rich array of national background data is rapidly becoming available against which local studies using the same methodology can be benchmarked.[13,14] These surveys

include the USDA annual Food Security Supplement to the CPS, which has been conducted by the U.S. Census Bureau every year since 1995 (available from the Census Bureau's Website, www.census.gov). The core module items are also being collected by the Survey of Program Dynamics, a 5-year panel study to assess the impacts of welfare reform, the Early Childhood Longitudinal Study, the NHANES IV, and the CSFII. Comparison to these sources can facilitate interpretation of local study findings, provide context for comparisons to similar groups in the national population, and offer methods of quality assurance testing for the data collected.

In the CPS, the core module is administered both by telephone and in direct individual interviews using computer-assisted technology. However, the module is available in paper questionnaire form and has been widely used in that format throughout the United States and in Canada. Studies have successfully implemented the core module as a self-administered questionnaire in Special Supplemental Nutrition Program for Women, Infants and Children (WIC) clinics and county social service departments.[33–38]

To help make the core module accessible and easy to use, USDA provides guidance materials, most recently updated in the *Guide to Measuring Household Food Security*[14] and posted at the FNS Website (www.fns.usda.gov). Finally, for researchers who would like to estimate the scale values unique to their own survey population by fitting the Rasch measurement model to their own data rather than using the standard values derived from the U.S. population, ERS has offered to provide that service as well as part of the continuing USDA research effort into the characteristics of the measure.

A frequent misunderstanding about the 18-item core module is that it must be very long and burdensome to administer. The module is designed to reduce survey burden by means of two successive stages of screening within the 18-item sequence. The majority of households in a typical U.S. population sample are asked just three to five questions (depending on whether they have children) and are then screened. The second level of screening reduces still further the number of households that are asked all 18 items. With these two levels of internal screening, the estimated average time to administer the module in a general U.S. household sample is about 2 minutes. For samples heavily targeted to low-income households, the average survey time needed is about 3 to 4 minutes.

***Standard 6-item subset of the core module.*** For situations in which time constraints or a lack of computer-assisted interviewing capability precludes use of the full 18-item scale, a 6-item short form of the scale has been developed for use across population samples. The scale has been shown to closely approximate the three main categories of the 18-item food security measure: "food secure," "food insecure without hunger," and "food insecure with hunger."[37] Owing to time constraints, the short form does not distinguish between the two most severe categories of food insecurity and does not include questions about hunger among children. The best 6-item subscale classifies 97.7% of all households correctly in relation to their classification under the 18-item scale. The 6-item scale performs slightly better in households without children than in households with children and does not reach the very severe range of food insecurity where children's hunger occurs. However, it does provide a reliable measure of risk of children's hunger.[14,38] The investigators note that the 6-item scale is relatively accurate and unbiased in a national sample but may be less accurate and more biased in samples with substantially different prevalence of food insecurity and demographic composition than the national sample of the 1995 CPS. This instrument is also available on USDA Websites (www.fns.usda.gov and www.econ.ag.gov/briefing/foodsecurity).

Researchers wishing to use food security scales should use all of the items in the version of the measure they select (i.e., either all of the questions in the 18-item version or all of the questions in the 6-item version). Considerable work has gone into the scale development process with the Food Security Scales (and also with the Radimer/Cornell food insecurity measure). Selecting individual items from these scales loses the advantages of comparability associated with the use of a proven instrument.

The core module used in national data collection asks about food security over the past 12 months. However, Bickel et al.[14] advised that the module can be used with shorter referent periods (e.g., by modifying each question to ask about the previous 6 months, the previous 3 months, or, indeed, whatever time period is most appropriate for assessing the impacts of the nutrition education program being assessed).

Accordingly, nutrition researchers may want to adapt the time interval employed in questions to fit the time period that is most appropriate for the duration of the intervention. For instance, if data collection takes place at the time of graduation from a 9-month nutrition education program, it may be appropriate to measure food security during the past 6 months. With a 9-month intervention in this example, one should avoid asking about food security over the past 12 months.

In other studies, it may be important to adapt the time interval of questions to correspond to the timing of data collection. For instance, if data collection takes place 3 months after the conclusion of a nutrition education program, then it may be most appropriate to ask about food security during the previous 3 months since this covers the period of time following the completion of the intervention.

Also, in a pre- and post-test design, it will be advisable to ask about a comparable time interval at both points of data collection. For example, if a post-test data collection asks about food security during the previous 3 months, it will be important to have the baseline data collection ask about food security over a comparable time interval (e.g., the previous 3 months) as well.

In general, people can provide more accurate information if they are asked to recall what happened over a shorter time period. However, there is a lower likelihood, over a shorter time frame, for food security to have been experienced, and

asking about a shorter time frame may lose the advantage of contextual comparisons with trends in national surveys that ask about food security over the previous 12 months. In summary, the four scales described above (including the short form of the Food Security Scale) are reliable and valid for estimating the prevalence of food security and hunger in populations. The Radimer/Cornell measures and the CCHIP hunger index have been validated for identifying individual households with food insecurity. This type of validation is needed for program targeting and screening of households and for examining the effects of an intervention program on food security or hunger status of a household. The U.S. Food Security Scale has been found highly stable over time and consistent across diverse population subgroups, but none of the scales have been evaluated for sensitivity in measuring change in food security status of households or individuals. It will be important to do that to better understand the use of these measures to assess the effects of nutrition education efforts.

## INSTRUMENTS AVAILABLE TO MEASURE FOOD SECURITY AT THE COMMUNITY LEVEL

Another area of food security assessment that is of interest to nutrition educators working with low-income populations is the evaluation of change in food security at the community, rather than household, level. This type of measurement is critical to food security assessment as it relates to systems, the environment, and policy change (see the first article by Gregson et al. in this supplement). It is beyond the scope of this article to review this area of measurement in depth; however, two instruments were identified. One is the Second Harvest National Food Bank Network Agency Survey to assess hunger at the community level (personal communication, O'Brien D, Second Harvest, Chicago, IL, February 9, 1998) and the other is a survey used to collect data for the Task Force on Hunger and Homelessness under the U.S. Conference of Mayors (personal communication, Turpin R, U.S. Conference of Mayors, February 12, 1998). Neither of these surveys has undergone survey development testing, and further work is needed in this area.

## IMPLICATIONS FOR RESEARCH AND PLANNING

Each of the food security and hunger measures described in this article may be potentially useful for program evaluation, but they differ in the level to which they have been evaluated and how they have been administered. All have been administered to ethnically and racially diverse populations. However, since many nutrition education programs are targeted to very specific populations that may differ in circumstances and culture from those participating in national surveys, all of the scales should undergo research before being used for program evaluation purposes with these populations. Two examples of the type of research that could be done are cognitive testing, as described by Alaimo et al.,[39] and the validation project of Derrickson et al.[40,41]

For an instrument to be useful for determining whether a nutrition education program has had an effect on the food security status of a household or individual, it must be evaluated for how sensitive and specific it is in measuring the actual food security status of the household or individual. The challenge in this type of research is to identify an appropriate criterion measure for food security and then to determine the household's status in relation to this standard. Although some studies have looked at the relationship between measures of food security and dietary intake,[16,17] it is not clear that dietary intake of specific nutrients should be assumed to be the sole, or even most appropriate, criterion standard against which the validity of a food security measure should be compared. Other potential indicators might include food availability, reliable access to food from nonemergency settings, and a psychological sense of well-being about food security, although these indicators have not been conceptually well defined.

Only three measures, the Radimer/Cornell measures, the CCHIP hunger index, and the NHANES III version of the food sufficiency question, have been evaluated for specificity and sensitivity. The first two have good specificity and excellent sensitivity and thus would be helpful in program evaluation. The latter has excellent specificity but poor sensitivity, so it would not be good for program evaluation. This is an important area for further research.

As important as validity and reliability are, they are not sufficient criteria for characterizing the measurement properties of instruments that will be useful for program evaluation. For evaluating the effects of nutrition education programs, it is necessary to assess a measure's responsiveness or sensitivity to intervention. None of the scales or other measures described above have been evaluated on this characteristic. Therefore, this is a fruitful area for further research.

As instruments are examined with regard to their use in measuring change in nutrition education programming, another aspect to be considered is the way in which they are administered. As previously noted, the only evaluation commonly used in educational forums as of the writing of this article is the single food security question used on the EFNEP reporting system. Anecdotally, we know that program participants may be reluctant to share information with strangers in person regarding their ability to feed their families. Likewise, program participants may respond in a similar manner during in-person post-tests to please their educators. This potential problem is a broader issue that concerns any instrument used as a pre- and a post-test under similar circumstances. For example, one study compared the collection of sensitive information via face-to-face interviews versus telephone interviews by comparing unit and item nonresponse rates, sample coverage, and levels of self-reported drug use.[42] Sensitive questions may be better assessed using a random sample in an anonymous manner, and more valid responses may be given when improvement is measured as a

function of the participants' perceived degree of improvement at postintervention only, instead of comparing pre- and post-test responses. A study by Kuehn et al. compared responses in a WIC population of an interviewer-administered versus a self-administered version of a six-item food security scale.[35] Although the responses were roughly comparable, the study found that "the self-administered questionnaire seemed slightly more reliable." Hence, this is a promising area for investigation.

Another area of research to examine is the need for additional indicators to assess food security changes that occur as a result of nutrition education. That is, nutrition education may lead to identification of additional indicators of food security, such as those regarding reduced use of unsafe food acquisition practices by low-income populations (e.g., scavenging, community gardening in soil contaminated by lead, and fishing in contaminated waters). Further, if such behaviors are found to be prevalent in certain areas, they should be considered for inclusion in other food security measures.

On careful review of the definition of food security, it becomes apparent that, in a very practical sense, general measures of food security are useful and necessary. However, the most comprehensive measure of the food security status of individuals, households, and communities would consider compiling measurements related to the constructs identified by the authors of the various articles in this supplement. This is why there is a need for measurement in each of the core areas identified: dietary quality, food safety, shopping/resource management, and systems and environmental change. To make improvement in each, or perhaps any, of these areas is to move toward improved food security.

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